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NATAL.

DEPARTMENT OF AGRICULTURE.

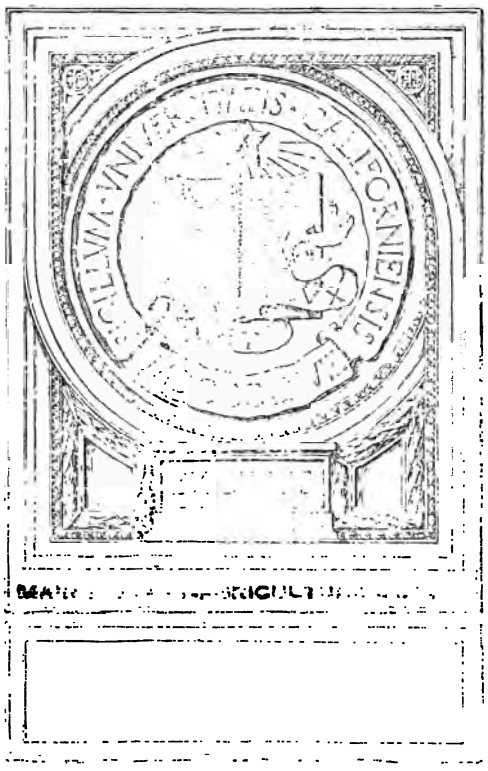
FIRST REPORT

OF THE

GOVERNMENT ENTOMOLOGIST.

1899—1900.

PIETERMARITZBURG, NATAL.
P. DAVIS & SONS, GOVERNMENT PRINTERS.
1901.



UNIV. OF CALIFORNIA

NATAL.

FIRST REPORT OF THE GOVERNMENT ENTOMOLOGIST, 1899-1900.

ERRATA:

P. 3, l. 8, for "1889" read, "1899".
P. 4, l. 24; P. 56, l. 15; P. 57, l. 33; P. 59, l. 53, and P. 68, l. 45; for "Queckett" read, "Quekett".
P. 6, l. 1, and Index ii., read, "Itinerary".
P. 10, l. 10; P. 14, l. 37; P. 47, l. 2; for "Mapston" read, "Mapstone."
P. 10, l. 18, delete, "sort".
P. 11, l. 26, read, "fallacious".
P. 13, l. 31, read, "inquiries".
P. 16, l. 21, for "or" read, "of".
P. 18, l. 5, read, "chlorotic".
P. 23, l. 30, 40, read, "downy".
P. 23, l. 41, for "some copper" read, "some salt of copper".
P. 24, l. 12, delete, "more".
P. 26, l. 25, for "cared animal" read, "cared-for animal".
P. 29, after the Tick Wash formula, insert whole of paragraph 3, P. 114.
P. 37, l. 9, read, "aquatic".
P. 40, 2nd last line, read, "forms".
P. 44, l, 26, Index ii. and iii., for "*Heliothris*" read, "*Heliothis*".
P. 45, l. 23, read, "Paris"; l. 31, read, "Coolie"; l. 46, read, "unmistakably".
P. 46, l. 5; Index ii., read, "*Diotræa*".
P. 47, between the 4th and 3rd lines from bottom insert, "margin, each of these spots is bordered outwardly with areas of a".
P. 51, l. 47, read, "*Thyridopteryx*".
P. 52, l. 44, for "as an acrobat" read, "as clever an acrobat".
P. 52, l. 46, delete, "in the manner".
P. 53, l. 32, read, "thoracic".
P. 55, l. 29; P. 56, l. 37; P. 59, l. 34; P. 60, l. 16, read, "*lienardi*".
P. 55, l. 30, read, "*Sphingomorpha*".
P. 55, last line, read, tibiæ; also P. 58, l. 16.
P. 58, l. 44, read, "channelling".
P. 58, l. 53, read, "There".
P. 59, l. 23, read, "nor"; last line, read, "liburnum".
P. 61, l. 7, read, "introduction"; l. 16, read, "caterpillars"; l. 29 and Index ii., "*cerealella*".
P. 67, l. 15 and Index, read, "*Calandra oryzæ*"; l. 20, read, *oryzæ*.
P. 69, l. 7 and Index, read, "*boas*"; l. 25, read, "abdominal".
P. 72, l. 15, read, "*capitata*".
P. 72, l. 27, read, "iridescent" and "basal".
P. 77, l. 47; P. 78, l. 13 and Index ii., iv., read, "*Sarcopsylla*".
P. 78, last line after "Fig. 1 and 2" insert "(much enlarged)".
P. 84, l. 40, read, "colloquialism".
P. 87, l. 1, read, "APHIDES"; l. 40, for "well-known" read, "well-written".
P. 89, l. 40, read, "apparatus".
P. 99, l. 27, read, "gases"; last line, delete, "besides a".
P. 103, l. 47, read, "subsists".
P. 107, l. 19, read, "entirely".
P. 108, l. 30 and 31, read, "*Bromeliæ*".
P. 109, l. 1, read, "scaly".
P. 110, l. 7, read, "*Orthezia*".
P. 125, l. 32, read, "Audouin".
P. 126, l. 1, read, "severely"; l, 29, read, "uniformly".
P. 127, l. 17, read, "moult".
P. 133, l. 52, read, "dries".
P. 136, l. 13, read, "superficial"; l. 40, read, "earliest".
P. 138, l. 36, read, "saphrophytic",
P. 142, l. 9, read, "vitriol".
Index i., read, "caterpillars"; ii., iv., read, "*Sarcopsylla*", iii., read, "*Apate terebrans*".

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OFFICE OF THE GOVERNMENT ENTOMOLOGIST,
PIETERMARITZBURG, NATAL,
MAY 16TH, 1901.

LETTER OF SUBMITTAL.

THE HONOURABLE MINISTER OF AGRICULTURE.

SIR,—I have the honour to present herewith my report for the year 1900, and the period which elapsed between August 10th—the date upon which I commenced duties—and December 31st, 1889.

The subject matter has been divided, for convenience and reference, into three parts. Part I is devoted to a general résumé. Part II. has reference to special subjects. Part III. has been prepared in consideration of the many requests I have received for general information concerning the pests of the Natal "farm and garden," and, in it, I have endeavoured to furnish brief descriptions of some of these, with suggestions for their control.

Many of the subjects touched upon are not usually regarded as within the province of an Economic Entomologist. They, however, find a place in this report because, in the absence of other specialists, they have fallen to my share, and constituted no small part of the work of the branch. I refer in particular to fungus and other diseases of plants, and to questions relating to fruit culture.

Respectfully submitted,

CLAUDE FULLER.

Entomologist.

485849

ACKNOWLEDGMENTS.

It is my pleasant duty to preface this report with a series of acknowledgments to those to whom I am indebted for many favours, and it is no easy matter for me to word my thanks sufficiently.

I fear I should be wanting in the barest courtesy were I to forget to mention first the favours of my friend, Chas. P. Lounsbury, Government Entomologist of Cape Colony, for to him I am indebted for much valuable advice and help. To L. Peringuey, Entomologist and Sub-Curator of the South African Museum, Capetown, I am also greatly beholden, chiefly on account of the series of Coleoptera which he has from time to time determined for me. I have great difficulty in expressing all my obligations to Dr. B. T. Galloway, Chief of the Division of Vegetable Pathology, and to Dr. L. O. Howard, Chief of the Division of Entomology, of the Department of Agriculture, Washington, U.S.A., for their many kindnesses. At the same time I have to extend my thanks to the many Agricultural Experiment Stations of the United States, and the Entomologists attached to them, for the ready kindness with which their various publications have been sent to me. I am also under obligations to Miss Eleanor A. Ormerod, the esteemed lady entomologist of England, and to G. B. Buckton, Esq., F.L.S., Haselmere, England, for the determination of material.

To my esteemed friend, J. Medley Wood, A.L.S., Curator of the Botanic Gardens, Durban, and to friend J. F. Queckett, Curator of the Durban Museum, I owe my thanks for a great deal of disinterested assistance. Whilst to the Rev. J. R. Ward, late of Richmond, and to Captain Montgomery, "Ismont," Mid Illovo, I have to express my gratitude for many examples of natural history and voluminous correspondence.

PART I.

GENERAL RÉSUMÉ.

So long a period has elapsed since I assumed duties, that there can now be hardly any call for a statement as to what were my original intentions with regard to the carrying out of those duties, as Entomologist to the Government. That I had neither occasion nor opportunity of indicating the lines upon which I anticipated conducting my work, is more fortunate for me than otherwise; for I fear that, had I designed any recognised plan of entomological work, it would not have met the ideas nor approbation of those whose advocacy led to the appointment. It is undoubtedly true that, in asking for the appointment of an Entomologist, the farmers of this country were considerably in the dark as to the limitations of his calling. There can be no two questions on this point, for the subjects which I was at first specially asked to investigate were Mealie Blight, Forage Blight, and Potato Blight. All three are matters for the Vegetable Pathologist, and entirely outside the province and profession of an Entomologist, whose calling is restricted to the study and economy, in its widest sense, of insects and their relations. In submitting this report of my work, therefore, I wish this point to be particularly borne in mind; and also that, in endeavouring to meet the wishes of those who appointed me (by doing my best to investigate these troubles of a fungus and physical nature), I have undertaken work outside my duties, and at which I make no profession of being an expert. Work which I should never have attempted, had it not been for a fortunate insight gained into a few of its methods during the short time that I served as laboratory apprentice under the now well-known Vegetable Pathologist of New South Wales, Dr. Nathan A. Cobb. At the same time I wish it to be understood that any proper and practical work upon these extraneous subjects, as well as upon many questions of an entomological nature, has been severely handicapped or entirely prevented on the one hand by the poor temporary quarters in which the Department was so long housed, and upon the other hand by the want of a Government farm where practical experiments, directly under control, could be conducted. Briefly, my work of sixteen months, treated in detail subsequently, may be roughly classified as under.

1. Paying visits, usually by invitation, to various farms and plantations, with the double purpose of furnishing such advice as lay within my power, and acquiring some knowledge of local conditions and methods.

2. Endeavouring, by various means, to have certain suggestions adopted for the control of insect and fungus pests.

3. The dissemination of information by correspondence, or through the medium of the "Agricultural Journal."

4. Cursory studies into the cause and natural history of several plant diseases.

5. The collection of insects of economic interest, and brief studies into their natural history.

6. The preparation of special reports upon matters of departmental interest.

7. The preparation of regulations, the object of which is to prevent, as far as possible, the introduction into the Colony of a number of insect pests, etc., from which we are yet free, and the inauguration of the enforcement of these.

I. Itinery.

During the period of sixteen months, I have had occasion to visit some fifty-eight different parts of the Colony, somewhat removed from Maritzburg. Owing to military operations, however, these have been limited to the lower half of the Colony. Forty visits were paid to individual farms. Upon four occasions meetings of the Inanda Agricultural Association were attended, and, in one instance, a short lecture read before that body. The first of these visits was made upon my own initiative, the remaining three by invitation; and I may safely add that the result of this forced acquaintance with the Association, upon my part, has been of mutual benefit to the Association, the Department, and myself. Upon several occasions I have gone to Durban, latterly in connection with the inauguration of the Import Regulations, mentioned above, and previously with the object of collecting information and making observations. Three visits were paid to Tongaat, in connection with the poisoning of locusts.

The difficulty of getting into touch with the farmers I feel greatly and, whilst I have always met with the greatest hospitality and kindness from those with whom I have come in contact, there is no general desire upon the part of farmers as a body to even ask for advice, they preferring, as a rule, that of the agricultural experts of the daily Press.

The liberty given me by the Honourable Minister to visit farms I have thoroughly appreciated, although it seldom occurs that these visits are productive of anything more than an establishment of mutual confidence. This in itself is, of course, most desirable, and its achievement has, in a number of instances, I believe, been followed by satisfactory results. In all my visits, a little knowledge of the principles of fruit culture and pruning has stood me in very good stead, for in few other British Colonies are cultural methods and pruning more systematically neglected than in this. In the matter of fruit culture a few have profited from lessons in the expensive school of Dame Experience; but there is still much to be learnt, and a practical Horticulturist could accomplish much good. The advantages which would accrue to the community from such an appointment I have already alluded to in official minutes, and I take a further opportunity of advocating such an appointment here.

II. Treatment of Pests, etc.

In the endeavour to have certain of my suggestions for the treatment of pests, plant-diseases, etc., adopted, I have met with that amount of success and disappointment which falls to the lot of most "agricultural experts."

One of the immediately successful recommendations has been the adoption of the Knapsack Spray Pump, for the distribution of "locust poison." This is referred to in detail later on, and the success of the innovation has led to many pumps being distributed amongst planters to whom they and their uses were previously unknown. The successful use of spray pumps and spraying against the orange mussel scale has also been demonstrated, and several parties have adopted this method of dealing with the pest, with satisfaction. In contending with the red scale of citrus plants, I have made a point of recommending fumigation with hydrocyanic acid gas, in preference to spraying. The actual working of the Government fumigating outfit is, of course, outside my department, but it is competent for me to say that this

PLATE I.

H. Eyle Shaw, photo.

Fumigation House at Botanic Gardens, Durban.

arrangement for treating orchards has given satisfaction. Where disappointment has arisen it has been due, in some cases, to an over-estimated idea of the efficacy of the treatment, and in others when it was used against the orange mussel scale, which is a pest whose natural history renders its extermination from an orchard by this means quite impossible with one treatment and, on account of the cost, equally impracticable with several. To take a specific case: An orange grove badly infested with mussel scale was well fumigated throughout. The immediate result appeared most gratifying, the new growth put on by the trees giving tangible evidence of beneficial treatment. All the eggs of the insects were not, however, reached by the gas, and so a fresh brood started developing immediately throughout the grove. The summer was dry and the winter warm, consequently the pest developed rapidly, and in five or six months was worse than it had ever been. The case came under my personal observation twice, the first occasion being shortly after the treatment. At that time I drew attention to the fact that a new brood was developing, and recommended spraying with paraffin emulsion. Five or six months afterwards, when I again saw the orchard, I witnessed an infestation worse than it had ever previously been my lot to see. Every tree showed limbs, leaves, and fruit purple with scale; whole limbs were dead, and many trees seemed past recovery. Questioned as to why the suggested spraying had not been carried out, a reply, to the effect that it had been announced that, in any case, the fumigation treatment would give immunty for two or three seasons, was received; and so my advice had been disregarded. Since then I am assured that spraying has given satisfactory results in this orchard. This case is mentioned because it is one of many others.

In several instances, growers with a small number of trees, have been induced to acquire covers, and do their own fumigation for red scale, and, to help these, the Minister was good enough to approve of the suggestion to furnish cyanide of potassium at cost price. With the first lot, obtained before my appointment, it was found that this could not be supplied at less than two shillings and sixpence per pound. A further lot of equal quality, and showing a saving of over £100, was obtained, at my recommendation, from Germany, and this is now supplied at the more reasonable figure of one shilling and threepence per pound.

With regard to the treatment of nursery stock before delivery, it is satisfactory to report that, during the year, in two nurseries at least, fumigation has been adopted for this purpose, and chambers built in which to treat stock. I refer to the Durban Botanic Gardens and Messrs. Wilkinson and Co.'s nursery, Maritzburg. The fumigatorium at Durban Gardens is an excellent one of its kind, and is illustrated upon Plate I. Its cost was a little over £30, and the building does not compare unfavourably with one erected at the Point, Durban, for treating imported stock. (*See Plate II*).

One of the chief suggestions made has been the spraying of potatoes with Bordeaux Mixture for Potato Blights. This has been advocated upon the strength of the excellent results reported from its use in the United States of America and in England. I cannot say that the suggestion has been taken up to any extent, though I must admit that the difficulties in obtaining pumps and good materials constitute considerable drawbacks. In one case I sprayed a portion of a field once, and the sprayed vines lived about fourteen days longer

than the unsprayed. Towards the beginning of this season I also induced some parties to take the matter in hand, and, partly at the expense of my vote, a ten-acre field was treated with a machine "rigged up" upon the farm to spray four rows of vines at a time. Three sprayings were applied, but the experiment was without result, the attack of blight being even throughout the sprayed and unsprayed portions. The reason for this comparative failure was difficult to assign, but, considering that another small experiment upon a neighbouring farm gave satisfactory results, the application in this case being made with a hand pump, I have been driven to the conclusion that a sufficient quantity of fungicide was not at any one application put upon the vines.

This deficiency was, in a measure, due to the pump not being sufficiently powerful, and also to the pace at which the oxen travelled being too fast. Failures such as this are particularly unfortunate in a small country and among a small community, where immediate results are looked for and circumstances seldom taken into account. It must not, however, be sufficient to deter future work in this direction, and I hope to be able to conduct further trials next season with a properly designed horse-power sprayer; for I am sure some such labour-saving appliance will be necessary to meet local requirements.

I have already mentioned the drawbacks with regard to obtaining materials and spraying machinery. Quicklime, for instance, is imported from England, and is difficult to obtain and not cheap. Whale oil or fish oil is often unobtainable, whilst paraffin, a most useful and necessary insecticide, pays an import duty, and costs from one to two shillings a gallon. Good bluestone costs 32s. per cwt. Spray pumps are not readily obtainable, although I have succeeded in inducing several firms to stock approved patterns, and prices are at least 20 per cent. in advance of those ruling at Capetown.

III. Correspondence, Publications, etc.

There exist three mediums for disseminating information other than by visiting farmers or their associations. Of these, of course, correspondence plays the most important part. During the term covered by my report this has not been inconsiderable, but the bulk of it I have opened myself, and I doubt if I could point to more than a few instances where advice has been actually asked for. Altogether, some 540 letters have been dispatched, and 512 received in the sixteen months.

Visitors to the office form a second medium, necessarily small, but still important; and I only regret the fact that farmers coming to the city do not make a point of looking up their experts, and gaining some knowledge of their office life. Such an acquaintance would, I feel sure, lessen that opprobium which it is so usual here to shower upon an "expert." The third medium is the "Agricultural Journal." From my point of view, however, contributions are not satisfactory, for the "Journal," or, at any rate, the information I supply to it, should be distributed free. The contention that, if it is worth having it is worth paying for, is an unworthy one, which I do not hold with. If advice is to be given through such a medium, it should be gratis, and distributed broadcast.

The following is a list of contributions:—

Title.	Illustrations.	Form.	Page.
			Vol. II.
sts in Imported Fruit Trees ...	...	Letters, &c.	417
rus Pest	...	Letter	451
raying of Orchards and Gardens, Part I.	Eight	Article	503
raying of Orchards and Gardens, Part II.	...	Article	518
uit Fly...	Two	Article	590
			Vol. III.
ust Destruction	...		98
ange Worm	...	Press Note	136
uning Fruit Trees	Five	Article	137
rley Blight (*Erysiphe graminis*)	...	Note	197
rage Blight (*Puccinia Coronata*)	...	Note	199
tato Gall-worms, etc. ...	One	Article	220
ange Growing	Eight	Article	265-270
own Gall	One	Note	369
alie Blight		Note	389
uit Tree Importation Regulations			395-6.
rage Rust		Note	419-420
aucaria Pine Scale Insects ...	Two	Note	425-7
w Sugar Canes		Report	485
ger Fleas in Pigs		Report	545
ato Blight (*Macrosporium solani*)	Two	Article	585-8
e Jigger Flea, by *Arnold Cooper*	Two	Article	659

IV. Plant Diseases.

Preliminary studies into the cause and nature of several plant eases have occupied a certain amount of time. First among these the Rust of Oats (Forage Blight), Chlorosis of Maize (Mealie riegation), and the Mealie Witchweed, all three of which are ılt with separately later on in this report. A number of other eases have also received a certain amount of attention, but not that they deserve. Among these I may mention Potato Blights ree), Coffee Blight, Tomato Blight, Tobacco Diseases, Cankers and eases of Citrus trees.

V. Insect Pests.

Studies have also been commenced in relation to various insect its of importance. Much, however, remains to be done, and the ults of my observations will be found more readily in the third t of this report. Among the chief of these pests I may mention e the following:—

The Plague Locust.
Fruit and Pumpkin Flies.
Fruit Boring Moth.
Fruit Piercing Moths.
Fruit Beetles.
Scale Insects (various).
Woolly Aphis.
Bag Worm.
Lucerne Butterfly.
Jigger Flea.
Maggot Fly.
Onion Thrips.
Ticks.

VI. Official Minutes.

A number of official minutes, addressed to the Honourable Minister or to the Commissioner, have been specially prepared, of which I may cite the following:—

(1) Agricultural Education and Experimental Farms.

(2) Locust Poisoning, and the work done in this connection by the Inanda Farmers' Association.

(3) Locust Poisoning in Kafir Locations.

(4) Horticultural Expert: The need of one, and his duties.

(5) Rust Proof Oats, and the purchase of Mapston's oat crop.

(6) Rubber Conservation.

(7) Legislation to control the introduction of Insect Pests.

VII. Import Regulations.

The inauguration of the thirteen regulations controlling the importation of fruit, fruit trees, plants, etc., in order to prevent the introduction of further insect pests from places outside the Colony, took place towards the end of the year. In matters such as this sort it is usual to wait until the parties most interested in the matter make the first move, but, recognising the necessity for some action in this direction, and finding the necessary legislation already upon the Statute Book, I took it as my duty to act upon my own initiative. It is only fair to say, however, that such action had been proposed before, but fell through owing to the opposition of the very parties in whose interest it had been conceived.

The text of the present regulations will be found as an appendix, together with a copy of Law No. 15, 1881. Concerning them, I may say here that, in drawing them up, they were modelled as nearly as possible like those in force in Cape Colony for the sake of uniformity. An important difference is, however, to be found in those dealing with the importation of stone fruits from North America. The Cape Regulations absolutely prohibit such importations on account of the two diseases, "peach yellows" and "peach rosette." It was not considered necessary that ours should be so stringent, as there are undoubtedly wide areas in the United States quite free from these diseases, and so provision was made to facilitate importations from such areas; it being recognised that it is to the States we look for new and important varieties of these fruits. Upon the whole, however, the regulations are not favourable to importations from America, the fact that the consignments will have to be examined at Durban acting as a strong deterrent. This is not altogether to be regretted, for I believe, with others, that intending planters of fruit trees will obtain greater satisfaction from African raised trees than from American. And, if it were only realised that small, sound trees are preferable to large ones, there would be little difficulty in obtaining reliable ones in the Mother Colony quite as cheaply as from America.

In promulgating the regulations it was found necessary to rescind a proclamation under the Act, absolutely prohibiting the importation of grape vines from Cape Colony. A second, absolutely prohibiting the importation of apples from Madeira, though more or less incon-

PLATE II.

Fumigation Shed, Point, Durban.

H. Ryle Shaw, photo.

gruous, was allowed to stand. The first was directed against the possible introduction of Phylloxera. This was quite reasonable, but it also debarred anyone from obtaining vines upon guaranteed, resistant stocks or acclimatized, resistant stocks from the most reliable and ready source, and, furthermore, the proclamation was ineffective, inasmuch as vines might be imported from anywhere else than the Cape Colony, whether Phylloxera was present in the particular country or not. Regulation I. now takes the place of this proclamation, and will, I believe, meet all requirements.

The second proclamation was framed with the worthy enough object of keeping out the Codling Moth. Unfortunately for its adequacy, however, that pest is even more common in Madeira pears, which were not excluded, than in the apples; and, quite apart from this, we have the fact that the pest might as easily reach us from many other sources.

I have alluded to the fact that regulations with the same object as these were drawn up for adoption at an earlier date. Mr. C. B. Lloyd, the Commissioner of Agriculture, drafted the regulations, but they met with so much opposition that they were never carried into effect. Originally their conception was due to representations from the Government of Cape Colony, which was anxious that Natal should adopt regulations of this nature, so as to render those in force in the Cape more effective. One of the arguments used against the enforcement of the original set of regulations locally, was that Natal had already secured *all* the insect pests of fruit trees. This idea is, however, quite fallaceous, for Natal is not, comparatively speaking, so overrun with insect pests as many imagine. Indeed, were I so minded, I could furnish quite a lengthy catalogue of insects which might easily be introduced, and which at present do not occur in the Colony. It is quite sufficient to say, however, that the regulations will have more than served their purpose if they are the means of excluding from the Colony the Pernicious Scale, the White Orange Scale (*Chionaspis citri*), the Codling Moth, the Pear Slug, and the Mussel Scale of the apple.

PART II.

SPECIAL SUBJECTS.

FORAGE BLIGHT OR OAT RUST.

PUCCINIA CORONATA.

Since the season of 1898 the rust of oats, known technically as *Puccinia coronata*, has been particularly virulent and destructive throughout the Colony, and, upon my arrival, its consideration was one of the first subjects which, as Entomologist, I was requested to undertake. As with Mealie Variegation, I fear I can lay no claim to having accomplished very much. In the first place, too much was expected. Though I could not fail to recognise the character and identity of the disease at once, I had to disappoint many who anticipated that an investigation into the nature of "Forage Blight" would show that it was some abnormal disease, for which methods of prevention, or even cure, could speedily be devised. Rust, in a modified and innocuous form, had existed for so many years that the significance of this form of disease was lost, and its sudden assumption of virulence was inexplicable, and caused something akin to consternation. Moreover, the investigations undertaken in other parts of the world in connection with rusts in cereals and their results were practically unknown here, and consequently it was thought that experiments upon certain well-worn lines would supply a remedy. These experiments were such as have already been tried in Australia, America, and elsewhere, with the same want of success. I refer, of course, to the application of fungicides or dressings to the plants, the seed and the soil.

General Observations.

It is a matter of common talk amongst farmers that about 30 years ago rust in oats became a prevalent disease. Then, up to the season of 1898 there was a general immunity from the disease, although during that period, I am told, there was always a certain amount of rust to be found in oat paddocks, but this was quite harmless in its effects.

It would appear that certain varieties of oats were introduced and grown during that time which were rust-resistant. Thus I am informed that a Mr. Siddons found, some twenty years ago, an oat which was rust-resistant, and satisfactory as forage—an important point in this Colony where oats are grown almost wholly as a forage crop, and but seldom as a grain crop. The gentleman referred to cultivated his "find," and afterwards sold the seed among the farmers, so that to this day it is known locally as the "Sidonian Oat." Then the "Cape Oat," a Scotch oat, I believe, has for years found high favour, being cultivated with success, and being almost, if not quite, the ideal forage plant for the Colony.

The epidemic of rust broke out suddenly in 1898, sweeping off the summer crops, and, in many parts, the winter crops were also rusted—crops which are even now satisfactorily grown on many farms with irrigation. Both the Cape and the Sidonian oat succumbed to the general epidemic, the former suffering, if anything, more severely than the latter.

There are two points which cannot be satisfactorily cleared up now. First, we shall never know what form of rust it was which

appeared thirty years ago, and, second, it is out of the question speculating what species of rust it was which existed in a harmless state up to the eve of the epidemic. The present rust, I am satisfied, is one known to exist in Europe and America, and called *Puccinia coronata*, but there are, however, several other species which attack oats, and one of these may have been the earlier culprit. Most farmers that I have met with stoutly maintain that the *Puccinia coronata* is a new disease, and that it is not the same rust as that formerly existent. This is a matter which no amount of discussion will ever settle, and it is quite possible that the present rust has always occurred in Natal, and that the outbreak of thirty years back was also due to it. Presuming this to be the case, what the conditions were which modified the disease for so long a period, it is difficult for me, as one quite unacquainted with the then local climatic conditions, to venture an opinion. Curiously enough, too, rust in oats has become virulent in Cape Colony and Rhodesia during the recent period that the disease has been destructive in Natal. It is, I believe, quite true that the locust invasion of 1896 heralded in a spell of bad seasons which has lasted until the end of 1900. This seems to have had some bearing upon the rust outbreak of 1898; and although this may be so, it would be unwise to use it as an argument that, with the return of good seasons, rust will again become innocuous as, according to the views of some farmers, it is already becoming.

In view of the importance of forage growing to the whole farming community, it appears to me essential that measures should be taken with a view of solving the problem, as is being done in other countries, by cultivating only varieties which will resist the rust. With this end in view, an extensive and continuous series of tests, with as great a variety of foreign oats as can possibly be obtained, should be inaugurated under the control of the Department of Agriculture. Towards this end inquires were prosecuted through the Agent-General as early as last September, but through some misunderstanding these were not sent to the quarters to which they were directed, so that much which might have been done has been delayed. This work, I trust, will be one of the earliest undertakings of the proposed model and experimental farm, as nothing is more confusing than the results of experiments conducted by different farmers upon different soils. Of course, it must be borne in mind that the experiments should extend over four or five years, and, although the results may not apply to the diversified conditions of soils of the Colony, still they will form a most excellent standard, and give most valuable results.

At present little is known as to what are the exact climatic conditions favouring rust, although much concerning this could be learnt if reliable meterological data and exact histories of crops were obtainable. In support of this contention I have only to instance the fact that upon the higher table-lands—say, at Ladysmith—a crop of winter oats, with sufficient irrigation, may come to maturity and not rust, whereas the same crop will rust off in the Maritzburg area.

As far as soils are concerned in their relation to rust, it is, I believe, generally conceded that rust is worse upon badly drained soils. Then again there is the question of soil deficiency, not necessarily poor soil, of course, but still soils which are deficient in one partciular constituent, or soils in which that particular constituent is not in an available form.

After a series of experiments conducted in Canada, the following conclusions were arrived at in connection with rust in wheat, which

may have some interest in discussing these questions. (1) Seasons are chief causes of rust; sudden changes of temperature and rain accompanied by close, sultry weather, are favourable to its increase. (2) Low-lying, rich soils are most subject to its attack. (3) An excessive use of manures, rich in nitrogen, encourages the disease. (4) Late sown crops are liable to attack. (5) Thinly sown crops are most liable to rust. (4 and 5, I fear, have little, if any, local bearing).

It is generally conceded that a still, moist atmosphere supplies the conditions most favourable to the development of rust, and rust generally breaks out in some shaded or sheltered spot, or in some low-lying, swampy spot, and from there it spreads rapidly over the field.

Returning to the question of rust-resistance, it is hardly likely that a rust-proof oat will ever be obtained; but it is reasonable to anticipate the discovery of certain varieties which will, to a considerable extent, resist the rust. The history of the Sidonian Oat alone supplies sufficient evidence of this, and, more recently, we have the case of the oat grown by Mapstone Brothers, at Manderston. The history of this latter oat, the purchase of the seed by the Department being largely on my recommendation, will not be out of place here. I believe the first intimation that reached me of the existence of a crop of oats growing healthy among rusted fields was in the report of the Farmers' Conference, last year, the subject being mentioned by Mr. G. Alexander. Some days afterwards Mr. John Moon, of Manderston, gave me further particulars regarding the oat paddocks on Mapstone Brothers' farm. On May 30th, 1900, in company with the Commissioner, an inspection of this uninfected crop was made. Briefly it looked very promising indeed. On either side were fields of Sidonian and Cape oats, red with rust, whilst upon the oat in question I was unable to detect any red rust whatever, and only an occasional pustule of black rust (puccinia) upon some of the older leaves. The presence of the puccinia form was not easy to account for, but it seemed as if the rust, after gaining an entrance to the tissues, had met with uncongenial surroundings, and these resting spores were produced. The second inspection was made on August 25th (13 weeks later), and upon that date I was quite unable to find any rust, whilst the plants stood well in ear. This was the second crop of the sort grown by Mapston Brothers which had resisted the rust, and, in view of the facts, that the exact origin of the seed was unknown, that the oat itself was quite as good as Cape for forage, and the good promise it gave of rust-resistancy, I now felt myself justified in recommending its purchase. This was done, and the seed distributed upon its merits. Thus in sending it out it was particularly specified that there was no guarantee of the oat being rust-proof, but a simple statement was made to the effect that, during two winters it had escaped rust, whilst Cape and Sidonian oats in the same paddocks had blighted off altogether. So far, I regret to say that no further data has accumulated in connection with this forage, but it is hoped that more will be known concerning it in time for my next report. It may be interesting to add that samples were also sent to America, Cape Colony and Rhodesia.

Natural History of Forage Blight.

In view of the slight amount of knowledge among farmers concerning the natural history of "rusts," I may be forgiven briefly outlining some of the more important features in that of Forage Blight or Rust here. In the first place, it has to be borne in mind

that the red rust which we notice when examining a blighted oat-plant is made up of many thousands of microscopic seeds or spores. Now the spores—as I shall continue to call them— are the fruit of a minute, parasitic plant known as a fungus, which has its roots ramifying through the cells of the oat plant, and collecting from them the nutriment essential to its growth. A fungus, as has been pointed out in another part of this report, is a plant which, being entirely destitute of green colouring matter, or chlorophyll, cannot assimilate inorganic food as do ordinary plants, consequently it has to derive its nourishment from organic material. This is found either in living plants or in decaying animal or vegetable matter, and it is possible to divide fungi into two well-defined groups, in accordance with the nature of the organic matter upon which they subsist. Thus those which feed upon decaying organic matter are known as saphrophytes, whilst those which draw their nourishment from living plants are known as parasites. Forage Blight is, therefore, a parasitic fungus which belongs to a group commonly referred to as "rusts," a name acquired from the millions of red spores they produce, which give to the affected plants an appearance calling up recollections of iron rust.

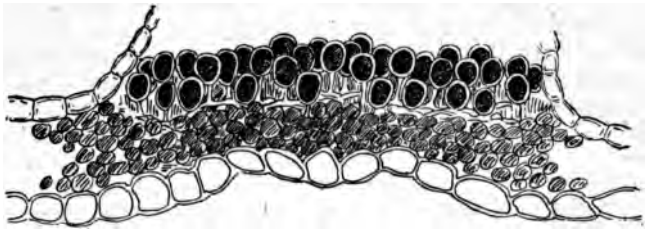
Now let us take a rusted oat plant and examine it carefully. Upon the green leaves we will notice many narrow, orange-coloured pustules (*See Plate III., figs.* 7, 8), some of which are covered with the thin epidermis of the leaf, whilst others are flowing over with little red granules. In order to acquire some knowledge of the origin of these granules, it is necessary to prepare very thin sections of the diseased area, and examine them with a microscope. This examination will reveal to the eye that the granules are the fruit or spores of a parasitic plant, whose roots can be seen ramifying through the tissue of the oat. (*See Plate III., fig.* 1.) The question which presents itself for explanation is, how the parasite became so associated with its host. We know that plants grow from seeds embedded in the soil, and it is, therefore, to the spores of the fungus that we look to discover how an entrance into the tissue of the plant was effected. To do this we must try and germinate them under artificial conditions, as approximate as possible to those under which they grow naturally, and in such a way that what happens may be observed under the microscope. The necessary conditions for the germination of these spores are warmth and moisture, and they can be cultivated readily upon a glass slide in a drop of water. Having then secured some spores (*see Plate III., fig.* 2), and given them suitable conditions under which to germinate and grow to some extent, we will discover, after an interval of a few hours, that the skin of the spore will break, and through the opening will proceed a thin, glassy filament. This is made up of the contents of the spore, and its winding growth can be easily watched. If, instead of being upon a glass slide, the spore had germinated upon the surface of an oat leaf, the filament sent forth by it would have wound across the leaf until it reached a breathing pore in the leaf's surface, and then it would have passed through that into the tissue of the leaf. (*See Plate III., fig.* 9). Here, having met with most suitable conditions for its development, it would grow vigorously, branching in different directions, and becoming interlaced as is the case with the roots of a plant in the soil. After a short time from this mass of roots will commence to grow a crop of spores similar to that from which it originated. This crop of spores becomes crowded under the epidermis of the leaf, and ultimately breaks through, and represents again the characteristic rust and pustule form from which was taken the original spore.

It is this form of rust which does so much damage in Natal, for it flourishes on many farms all the year round. In countries where the winter is severe, red rust is known as summer rust, because the red spores only flourish in the summer. Technically also this form of rust is known as the *Uredo* stage, to distinguish it from the *Puccinia* stage. In order to understand this second or *Puccinia* stage, one has to imagine a plant capable of producing two distinct kinds of fruit, for this is what the rust plant does. The second form of spore is usually found upon rusted oats in Natal during autumn and winter, and it must usually be looked for upon the lower and older leaves of the plant. Here, instead of the red or orange-coloured pustules, will be found very dark brown or black ones. If one of these is examined microscopically, as we examined the red pustules, the fungus parasite will be seen the same, except that the spores are of an entirely different shape and colour. These are called "teleutospores," or resting spores, and like the *Uredo* or red spores, they grow upon short stalks. The spores differ, however, considerably in shape and structure from a red spore, being compounded of two spores, the basal one being of a triangular shape, whilst the other, which is superimposed, is more or less square, and bears on its apex an irregular arrangement or "crown" or horns, from which character the name *coronata* is derived. (*See Plate III., figs.* 3, 4, 5.) A curious circumstance attached to this form of spore is that it does not germinate readily like the red spores, but has first to be subject to the influence of cold. Thus, for instance, spores collected and kept in my office for ten months over winter would not germinate, the temperature of the room not having been low enough.

From what is known of other rusts similar in nature to Forage Blight, one is able to say that these spores are produced by the parasite to insure its perpetuation. It is said of them that they retain their vitality for long periods, and also after passing through the alimentary canal of a beast. It is also claimed that in Europe these teleutospores (or resting fruits) germinate in the spring, after lying out in the fields during winter, giving birth to very minute reproductive bodies called secondary spores. These, it is said, are carried by the wind, and those which alight upon the leaves of a buckthorn grow and produce therein a distinct form of fungus (*aecidium*). This fungus again produces spores, which, being blown about in the atmosphere, are carried to oat and grass leaves, and germinating thereon, give rise to the typical red rust. It will thus be seen that, according to the belief of many botanists, the fungus which we call *Puccinia coronata* produces, under certain circumstances, no less than four forms of fruit, and has three well defined stages, two of which occur upon oats and grasses, and one upon an altogether foreign plant to these.

Practically nothing, however, is known concerning the natural history of the *puccinia* form in Natal, and the parts which the spores play in the maintenance of the disease; but from the fact that the red rust flourishes all the year round, up to a considerable elevation, they cannot have so important a bearing as in those parts of the world where winters are more severe.

Explanation of Plate III.—Fig. 1, cross section of red rust pustule; fig. 2, red rust or uredo spore; figs. 3, 4 and 5, various forms of resting or puccinia spores; fig. 6, diagram A shows comparative size of red spore; fig. 7, stem of oat showing rust pustules natural size; fig. 8, rust pustules enlarged; fig. 9, diagram showing red rust spore A germinating on leaf surface and sending the root B through the stomata or breathing orifice of the leaf at C into the interior. *Figs.* 1—8 *original*, 9 *adapted.*



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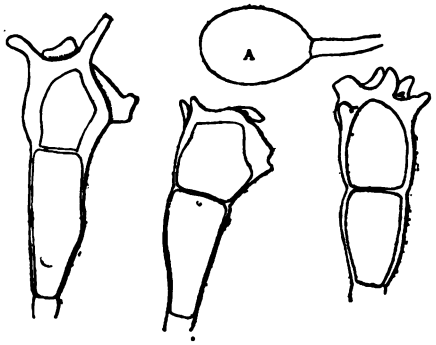

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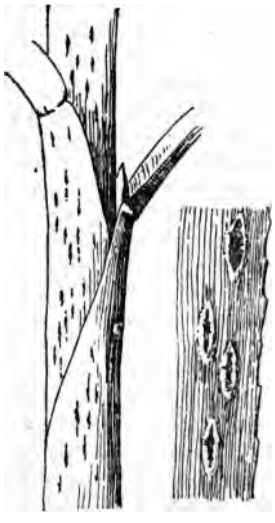

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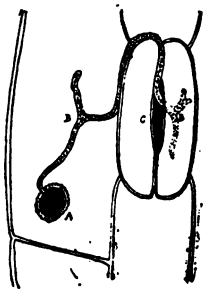


9.

Rust of Oats.

C

MEALIE VARIEGATION.

The disorder of the mealie plant, locally described as "Mealie Blight," "Mealie Yellows," or "Striped Leaf Disease," belongs to a group of plant troubles arising from obscure causes, concerning which plant physiologists are but slowly arriving at definite conclusions. The investigations which I have been able to conduct into its nature and causation have been seriously handicapped from want of facilities, and consequently up to the present little of a satisfactory nature has been arrived at. In the following notes, however, I have endeavoured to set down the observations I have made, and their bearing upon the question with the hope that these may eventually lead to some solution.

Mealie variegation, as I have already pointed out in a note, published in the "Agricultural Journal," for August 31st, 1900, is not due to insects nor fungi, nor is it, so far as I can determine, of a bacterial nature; at any rate, I have not succeeded in discovering any germ to which I could attribute the peculiar appearance of the affected plants. I have already described it as a form of chlorosis, and this I believe it to be, as there is often as much as 50 per cent. of the normal amount of chlorophyll absent from the leaves. That the loss of the chlorophyll is due to some primary cause is evident from the most casual observations, as is also the fact that the disorder does not spread within the tissues as would be the case if it were caused by a fungus or by bacteria. This is evidenced by the fact that when a leaf is formed it is already chlorotic to a certain degree, and does not become more or less so throughout its growth. Moreover, variegated plants are not, as a rule, any less vigorous or shorter lived than green ones. Another feature of variegation is that it does not spread from plant to plant, for perfectly green mealies may be found throughout their existence growing quite adjacent to affected plants.

The characteristic stripes may be eleven or twelve inches of unbroken length, or only a fraction of an inch in length; whilst, as a rule, they are chiefly made up of a series of elongated or almost circular spots.

It is claimed that variegated plants are diseased, and that, as a rule, affected plants produce poor and half-filled cobs. Mr. John Marwick, of Richmond, the only farmer who appears to have studied the disease sufficiently to put his ideas into writing (vide "Agricultural Journal," August 3rd, 1900), remarks that, whilst he had seen as good cobs upon affected plants as upon green ones, this, upon careful observation, he found to be unusual, and very few of the variegated plants bore cobs worth anything. Many farmers endorsed this opinion, but I must say that my observations do not confirm it in any measure. Indeed, after many examinations, I find it impossible to make any definite statement as to what the effect of the disorder, upon the whole, really is.

In every case of variegation it will be found, upon careful examination, that the earliest leaves of the mealie plant do not show any yellow stripes, and if the variegation be very bad, there will be a less number of green leaves at the base than if it is mild. Once it has appeared during the growth of the plant it invariably occurs in the later leaves, and generally becomes more marked.

Thus there may be noticed a very variegated plant, from the leaves of which 50 per cent. of the green colour is absent. This will represent one extreme. The other extreme will be found in the plant where only an occasional yellow stripe exists in some o

terminal leaves for, almost without exception, the slight cases are se where but the last or the last two or three leaves are striped.

Occasionally badly variegated plants of a stunted growth are nd, which give no promise of maturity, and one feels inclined attribute this to their cholorotic condition, but such an assumption l be upset by the discovery of equally yellowed plants, 12 to 13 t high, and bearing excellent cobs.

Distribution and Origin.

Mealie Variegation is prevalent in the seaboard counties, and s been noticed in the lower parts of Pietermaritzburg and Umvoti nties, up to an elevation of 3,000 feet above sea level. Above s belt, which extends roughly from Greytown, through Maritzburg Richmond, I have never seen the disorder, although careful search s been made for it. Whether elevation has such a direct bearing it appears to have, I am unable to say, owing to the difficulty of ertaining the elevation of various farms within the affected area. ave been informed that the disorder has been noticed upon the rthern side of the Mooi River heights, at an elevation of about 00ft., but have no further evidence of its occurrence there.

A curious difference of opinion exists regarding the date of the gin of this form of disease, some farmers maintaining that it is of quite ent origin, whilst others profess to have known it since they comnced farming 20 to 30 years ago. Take for instance the interesting dence of Mr. John Marwick, in the notes referred to above, upon this nt: "I myself," he writes, "first noticed the disease about 20 years . I distinctly remember the first mealies I saw affected by it. I was ing at the time, and out of curiosity noticed the spot where it was wing, and used to visit the plant to see if any change took place in its our. When first noticed, the plant was beautifully striped green and ite, and this continued until after flowering. Thereafter I used to ice occasional plants similarly affected among my own crops and also se of my neighbours. I paid but little heed to them, and regarded m as freaks of nature. The affected plants, however, continued r by year to increase in number. In the course of time the affected nts, instead of being occasional, constituted half the crop." Other alie growers in the neighbourhood of Maritzburg have assured me t they have been acquainted with variegated mealies in their lands at least 20 years; and the Hon. Thomas Kirkman, F.R.M.S., ueefa, a careful observer, has known the disorder for 30 years past n the coast in Alexandra County. In continuing his remarks, Mr. rwick mentioned that, whilst variegation was more common in ne years than others, still there was never so much as in 1896, ill-omened year of the locust invasion.

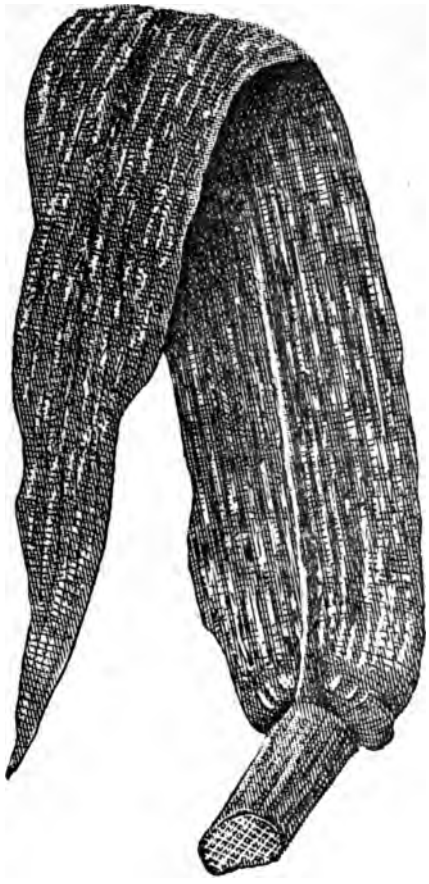
From other evidence which I have before me, it seems that it nly since 1896 that the disorder has claimed the attention of farmers the midlands. This is possibly due to its greater prevalence, and ally to the greater interest which seems to have been awakened the Colony in plant diseases during the past five or six years.

Observations.

The following observations have been made in connection with alie variegation.

1. The disorder, in its characteristic form, has been noticed in sinthe, amabele, oats, cannas, and four kinds of grasses, including

PLATE IV.



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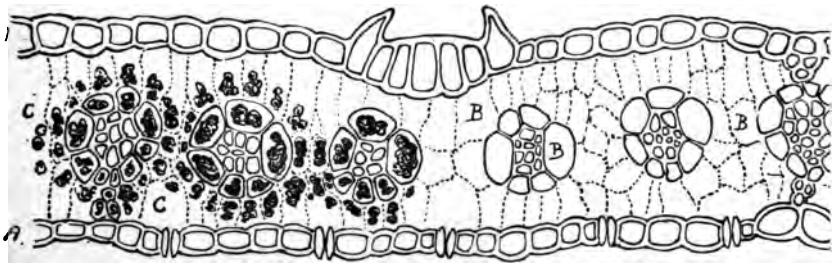


2.

Claude Fuller, del.

Setaria verticillata, Beauv., *Digitaria horizontalis*, Willd., *Eleusine indica* Gaertn.

2. Seed from American, Australian and local sources, sown near Maritzburg upon new land, which had some months previously served as a cattle kraal, produced variegated plants.

3. Seed taken from variegated plants and sown in Maritzburg produced variegated plants, but not wanting in vigour.

4. The same seed, sown at Ladysmith, produced green plants without variegation.

5. Seed from Mooi River, from a farm where variegation is unknown, produced variegated plants when sown in Maritzburg.

6. In the Umzinto district are large fields of mealies growing upon lands worn out by sugar cane, among them variegation is so common that it is difficult to find plants quite free from it. The crops are, however, good, the cobs full-sized, and the plants ranging from 11 to 13 feet in height. In the same neighbourhood a crop of mealies was examined growing in rich virgin land, from which the scrub had but recently been removed. Here variegation was as prevalent as in the sugar lands.

Conclusions.

1. The disease is not of an hereditary or contagious nature.

2. The soil is lacking in some constituent essential for the production of chlorophyll or such constituents are not in an available form; or,

3. That certain of the soils of the coast and tablelands are impregnated with some chemical enzyme, which has the property of producing this disorder, and if this be the case one must conclude

4. That many soils of the higher tablelands are either free from this, or its activity is controlled by climatic influences.

5. The disorder will be met by intensive cultivation, and the scientific application of chemical manures.

Explanation of Plate IV.—Fig. 1, mealie leaf showing variegation; fig. 2, a cross section through an affected leaf highly magnified, and showing A.A.A.A. the outer cells or epidermis of the leaf, B.B.B. cells, from which the chlorophyll granules are absent, and C.C.C. cells in which the chlorophyll granules (shown black) are present.

THE WITCHWEED.

STRIGA COCCINEA.

An inquiry into the relationship existing between the witchweed, or "is-ona" (*Striga coccinea*) and the mealie plant (*Zea mays*) is also among the extraneous matters which it has fallen to my lot to investigate. At the outset it may be said that a variety of opinions were, and indeed are, still held by different farmers as to what that relationship really is. Many have long recognised the evil effects this little brilliant red flower has when growing amongst mealies, whilst others again believed it had no ill effects, and saw no harm in it. That such opposite opinions should exist is indeed surprising, were it not for the proneness of farmers to judge everything of this sort simply as it occurs upon their own farms. These are several of the beliefs existent regarding the witchweed; some hold that it is a parasite, or else poisons the soil in some manner so that the mealie succumbs; others that it has a very strong vitality and in poor soils chokes out the mealie; others again that it has absolutely no connection with, and no ill effects upon, the mealie; whilst the Kafir, in his wisdom, holds that the plant bewitches his mealies.

To put the whole matter briefly, I am able to say that the witchweed is a native plant, dependent upon grasses for the continuance of its existence, which has adopted the mealie as a host. It is a parasite in the true sense of the term, and its effect upon its host is regulated partly by seasonable conditions and greatly by soil conditions. And so the farmer who sees no evil in it is fortunate in having a sufficiently rich soil to allow the mealie plant to come to perfection, and at the same time support the witchweed; whilst he who has learned from experience its propensity for mischief and correctly gauged it as a parasite, is not so favoured.

Before endeavouring to demonstrate the connection which exists between host and parasite, I may briefly describe one of the most striking examples of the potency of the weed which has come under my observation. This was in a mealie field belonging to Messrs. Hosking Brothers, situated in the Byrne Valley. In the centre of the mealie field was a large bare space, between $\frac{1}{8}$ and $\frac{1}{4}$ acre in extent. The spot was more or less oval in shape, and about twice as long as wide. The mealies around the margin were all withered, the leaves and upper parts being quite dead. These plants were between five and six feet in height, and had tasselled, but never cobbed. Among them the weed was luxuriating and seeding abundantly. In the spot itself most of the mealie plants had disappeared, and the ground was overgrown with many coarse weeds, its cultivation having been abandoned with the gradual outward growth of the witchweed. Among the weeds, however, were many small dead mealie plants, from 12 to 20 inches in height, which, curiously enough, had tasselled. The spot was said to have originated from a patch but a yard or so square, where the weed was first noticed. The effect of the parasite appeared first upon those next to it, and then upon those adjacent, and its spread might have, in this instance, been likened to the eccentric waves seen upon throwing a stone into still water; for it was possible to trace the spread of the weed by the different heights of the dead mealies. Moreover, so great was the effect of the parasite that it had itself died prematurely through killing its hosts. The oval shape of the spot was possibly attributable to the fact that the spot occurred upon a slight ridge, where the soil was naturally

shallow; so that the plants growing here were more susceptible to the effect of the parasite, and perished more rapidly than those growing in the better soil above and below the ridge.

With regard to the connection between parasite and host, to which I have already alluded, this was established in the following manner: Several plants of the witchweed were dug up with plenty of the soil clinging to the roots, and this was carefully removed by playing upon it with a strong spray of water from a force pump, so that the fine particles of sand and earth were washed away without breaking the tender root fibres, of which a large bunch is always to be noticed on pulling up a clump of witchweed from loose soil. An examination of the root system of the parasite was now rendered easy by floating the roots out in a shallow dish. Such an examination revealed to the eye—assisted by an ordinary magnifying glass—the following facts: 1. That part of the haulm or stalk of the witchweed which is below the soil is white, and stippled with bright red spots of an oblong shape. 2. The roots attached to the haulm are very fine, and not clothed with hairs, and further have the same oblong red spots which characterise the haulm. 3. In many instances these roots swell out into very small bluish bulbs, or are terminated by the bulbs, which, whilst dark in colour, are clearly part of the root system of the witchweed. 4. In every case each bulbule is attached to pieces of yellowish rootlets characteristically clothed with fine hairs.

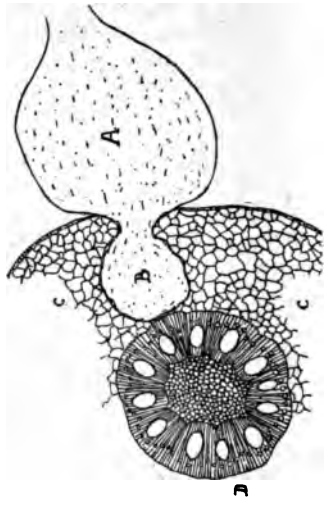
The question which at once arises in one's mind is: What is this second and distinct form of root? This is not at once apparent, for every one of them will be found to be broken. This, however, will be seen: Not one is attached to the bulbule in a natural manner. But suspicions having already been aroused, one naturally turns to the mealie plant for a solution. A plant is selected on account of the proximity of a witchweed, and it is washed and examined in a similar manner. After a little careful search, roots, coarse and fine, will be found with the characteristic bulbules of the witchweed attached to them, and, in this instance, instead of the yellow, hairy root being broken, it is that which proceeds from the bulbule. Thus is the connection between the two plants—host and parasite—clearly established.

There is still, however, a point to be cleared up, and that is, in what manner is the bulbule attached to the mealie root, and how does it influence it? In order to ascertain this, a much more critical examination is necessary, for both the interior of the mealie root and the bulbule have to be examined. This is done by making extremely thin cross sections of both bulbule and root at the point of attachment, and examining these with a compound microscope. This having been accomplished, it will be discovered that the bulbule, formed upon the root of the witchweed, not only has the power of clinging to the mealie root—as do the suckers or haustoria of an ivy to a wall—but they are also able to break down the epidermis of the root, and penetrate deeply into it, displacing the cells, and absorbing from the mealie root the juices which it has gathered from the soil for transmission to the plant above. (*See Plate V., figs.* 2, 4 *and* 5).

Having arrived at this stage, it is not difficult to realise how the mischief is done, for as the witchweed flourishes it taps the root system of the mealie plant more and more, and cuts off the supplies of the plant overhead. If the soil is rich, the mealie naturally has a vigorous and extensive root system, and can withstand this drain upon its supplies; but should it be in poor soil, or of weakly growth, it is readily affected.

PLATE V.

1.



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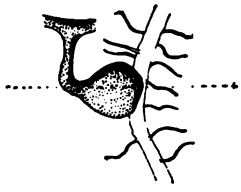

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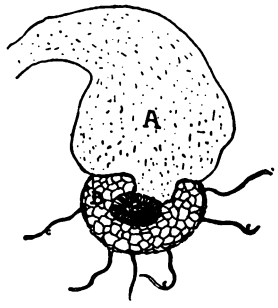

4.

5.

Claud Fuller, del.

It has been noticed that the witchweed appears only at a certain me, and when mealies have been planted early, they do not become fected, even when growing in a weak soil, where later sowings would ıffer considerably. In view of what has been said above, this can ɔ easily understood, for such mealies will have established themselves ıd made a good root system before the parasite attacks them.

The witchweed propagates by seed, and is a speedy and prolific ɜarer. Exactly how its seed germinates, I am as yet unable to say, as though many and various attempts have been made to germinate ıem, none have so far proved successful. It is a point which I trust ɔ be able to clear up next season.

The witchweed is often noticed in the veld, and in these cases is parasitic upon the roots of grasses. It occurs, so far as my obser- ıtions go, from the coast to the highlands past Ladysmith, and ·obably extends further.

This note would be incomplete without some remarks upon re- edial treatment, but I have been severely taken to task by a ɾrmer, who writes to the "Agricultural Journal" for April 27th,)00, criticising my remarks upon this pest in an earlier issue: I am rather sorry Mr. Fuller has given us the old thing over again ɔout brains and energy. We farmers had that want of brains and ıergy thrown at us years ago, and it comes as a regular thing. As result, the farmer naturally discounts any remarks embellished by *ese truths.*" The italics are the writer's, not the farmer's.

However, I must not be discouraged. For the witchweed a rota- on of crops is the correct treatment, so far as our present knowledge ' the vitality of the seed is concerned. But then a rotation of crops open to as much objection as the suggested intensive cultivation for hich I was taken to task. Where small areas are affected I would ɣain suggest hoeing them out thoroughly, both mealie and weed, and, ıould the land be put under mealies next year, such spots should ːceive an extra supply of kraal manure and bonedust. It has been ıggested to me that spraying, such as is said to be successful for ıarlock in England, should be attempted, and I have no doubt but ıat something of this sort might be successful, if applied when the itchweed is in flower, and the stalks of the mealies well hardened. I ɔubt, however, whether such a treatment could be made practicable.

Explanation of Plate V.—Fig. 1, showing root system of witch weed. The ots of the weed are dark, and the bulbules B.B.B.B. may be seen attached to the ɣhter coloured and hairy roots of the mealie C.C.C.; fig. 2, section of a large ealie root at the point where the bulbule A of the witch weed has attacked it, and ıtered in the form B into the tissue C.C.; fig. 3, witch weed bulbule attacking a naller mealie rootlet; fig. 5, a section of fig. 3 cut through where indicated by ıe dotted line; fig. 4, the same more enlarged.

TREATMENT OF INSECT AND FUNGUS PESTS.

The following chapters upon Spraying in Orchards and Gardens and Orchard Fumigation, have been compiled and added to this report for the sake of completeness. Both questions have already been dealt with fully in the "Agricultural Journal," but those articles will not, most probably, be accessible to many farmers, whom this report will reach.

SPRAYING IN ORCHARDS AND GARDENS.

It is not necessary to detail here the why and wherefore of spraying, as many intelligent fruit growers already recognise that it is as essential to successful fruit culture as pruning and proper cultivation, whilst the action of the various applications recommended, is reserved for later discussion. One sprays to kill the organisms which injure cultivated plants, and spraying is only rendered effective by a knowledge of the natural history of the pest which happens to prove troublesome; so that the insecticide or fungicide, as the case may be, is applied in such a form that the pest is likely to succumb to it, and usually at such a time that the pest is most susceptible to its effect. Historically speaking, spraying, or the application of liquids, as practised with machinery specially adapted and perfected to the purpose, is of recent origin, being practically unknown in its present form 20 years ago. Syringing was its forerunner. The origin of some of the insecticides and fungicides which we to-day make use of was, in many cases, accidental and the result of haphazard treatment, for originally substances for application were generally selected because of their distastefulness. Bordeaux Mixture, which takes its name from the town of Bordeaux, in France, one of the most successful copper combinations for the destruction of fungi, results from what must be regarded as pure accident. It appears that in the district around Bordeaux the downey mildew of the vine first made its appearance in 1878, and four years later the injury done by this blight was very considerable. Conspicuous in the diseased vineyards, however, were a few unblighted vines, situated along the highways, and their freedom from the mildew lead to the discovery. According to Lodeman: . . . . Vineyardists in these localities had suffered considerable losses from the stealing of their grapes by children and travellers along the highways. It had formerly been the custom to sprinkle verdigris upon a few rows of vines nearest to the road for the purpose of giving the fruit the appearance of having been poisoned. Several years before the appearance of the downey mildew this substance was replaced, for reasons of economy, by a mixture of the milk of lime and some copper, the sulphate being commonly used on account of its cheapness. . . . . The vines thus treated were the ones which retained their foliage through the autumn, while those growing further from the road lost their leaves. The cause of the beneficial action was soon ascribed to the copper, for lime used alone had proved unsatisfactory as a remedy for mildew."

All applications were not, of course, the result of accident, but were led up to by careful and systematic work upon the part of many investigators.

Spray Pumps.

Spray pumps, in all their variety, have been evolved from the old-fashioned garden squirt and syringe. Into the history of their evolution I need not, however, enter here, for it will be sufficient to

H. Ryle Shaw, photo.

The "Success" Bucket Pump in Use.

briefly enumerate those features which are essential to a reliable modern pump suited to local requirements.

In purchasing a pump, the first consideration will be what it is required for, as the purpose for which it is needed, and the use it is to be put to, have considerable bearing upon the pattern to be selected. Thus, for instance, if but a very small amount of work is to be done, say in a garden, or among a dozen or so of trees, what is known as a bucket pump will meet most requirements. If, however, the spraying is to extend over a larger area, particularly of low-growing plants, such as potatoes or turnips, say, up to an acre, or a hundred or so small fruit trees, or for distributing locust poison, a knapsack pump will be more preferable to a bucket pump. Should the pump be required for spraying a hundred or more large fruit trees, or several acres of potatoes, one suitable for mounting upon a barrel to be carried in a cart, upon a sleigh, or by means of trunnions, is required.

The Points of Pumps.

In selecting a spray pump, particular attention must be given to certain points, whatever be the style selected. Thus care must be taken to see that all the working parts are of hard brass, and not of any softer metal nor of rubber. Rubber parts are particularly objectionable in a pump, as it is not then suitable for all-round purposes, it being impossible to use such preparations as paraffin emulsion, etc., which rapidly destroy this material. Moreover, all rubber goods perish more or less rapidly in this climate. Simplicity of construction is another important feature, so that the machine is readily taken to pieces, and put to rights again, should it get out of working order.

Automatic agitators to keep mixtures well stirred whilst the pump is working are necessary adjuncts to all pumps, and, for preference, the "paddle" or "dasher" form should be selected. Other agitators in the form of a liquid return, have rather a fascination, I find, to purchasers, but they are best avoided, as they do not keep the mixture so well stirred as one might expect of them. As all spray pumps work by air pressure, one with a compact and strong, but not necessarily large, air-chamber, should be chosen. A good length of strong hose should be attached to every pump, and this is generally an extra, for what is sold with most pumps is never sufficiently long. If a long piece is attached, it is easier to elevate the hose to spray large trees.

Not by any means the least important part of a pump is the nozzle, for breaking up the liquid into a fine mist and distributing it evenly. Care should, therefore, be taken to select only simple and durable makes, and an extra supply should always be kept on hand. Of the two forms which recommend themselves, one is a cyclone nozzle, which breaks the liquid into a very fine mist, and is suitable for solutions such as paraffin emulsion, and arsenic, soda, treacle solution. The second, the "Bordeaux," is an excellent pattern, suitable for all round work, the tap enabling one to regulate the fineness or otherwise of the spray, and is particularly suitable for use with mixtures where the ingredients are in suspension, such as Bordeaux Mixture and Paris green, because by turning the tap the nozzle can at once be cleared of any obstruction. In spraying fruit trees it is often very desirable to have several nozzles attached to each line of hose, and for this purpose double and triple connections can be obtained.

Bucket Pumps.

These, as the name implies, are used to spray from buckets or small vessels, and, whilst quite a large number are manufactured, but few have found their way to Natal. On my suggestion, Messrs. Wilkinson and Co., of Maritzburg, and Messrs. P. Henwood, Soutter, and Co., Durban, have stocked a limited supply of the "Success" Bucket Pump, manufactured by the Deming Company, Salem, U.S.A. This pump has many desirable features, being made of brass throughout. It is strong and compact, and with fair use cannot get out of order. It retails at, I believe, 25s. The pump will do all the work that the more expensive Nixon Tripod is capable of, and, unlike that, will not keep jumping the bucket, and becoming clogged with mud. As a pump, the Nixon leaves little to be desired, but it is a barrel pump, and not suited to use with a bucket. (*See Plate VI.*)

Knapsack Pumps.

This class of pump is well-known in the Colony, but until recently the patterns supplied were of a very undesirable kind.

The desirable features of a good knapsack pump are: Working parts which can be easily taken to pieces, and a strong copper tank; and the bad points to be looked for are: Tanks of sheet iron or tin (for such are readily destroyed by the action of the chemicals used for spraying), and working parts which have to be carried in the hand. The defective pumps offered for sale in the Colony are of three kinds. In one the air pressure is maintained by a large rubber plate; this detiorates rapidly and cannot as a rule be replaced, nor are the whole of the working parts easily got at. In the second form the liquid gravitates down the hose, and is then forced forward through the nozzle by directing with the left hand, and working a piston with the right; this is a useless and annoying machine, and has a further bad feature in the form of a ball-like pressure chamber of thin brass, which is screwed on in a most uncomfortable position for the worker; this chamber is weak and ineffective. The third form is the least desirable of all, for the liquid falls by gravitation alone, getting an extra squirt through the nozzle by hand pressure upon a rubber ball.

The only reliable knapsack which is obtainable in the Colony was introduced under similar circumstances to the "Success" Bucket Pump. This is the "Galloway" Knapsack Spray Pump, and it can be confidently recommended to intending purchasers. The working parts are similar to those of the "Success,' bucket pump, and can be readily detached from the tank, which is a durable one of copper. The pumps retail at 60s. to 70s. apiece. (*See Plate VII.*)

A comparatively new feature that has been added to spray pumps and considerably improved upon recently, is the paraffin attachment. This device was invented for the purpose of mixing water and paraffin, and so doing away, to some extent, with the attendant delay of preparing emulsions. There are two separate tanks, into one the oil is placed and into the other the water. The two liquids become intimately mixed in their passage through the pump, which is designed to draw on both, and can be regulated to draw oil to a greater or a lesser degree, so that a dilute paraffin, of a known strength, is evenly distributed from the nozzle. These paraffin attachments are now made for all forms of pumps, knapsack, bucket and barrel.

This attachment will be found very suited for the Mussel Scale of the orange upon the coast, and attachments for bucket and knapsack pumps are obtainable from Messrs. Wilkinson and Co., Maritzburg.

PLATE VII.

H. Ryle Shaw, photo.

The "Galloway" Knapsack Pump in Use.

PLATE VIII.

SPRAYING TURNIPS.

SPRAYING POTATOES.

Barrel Pumps in Use.

Barrel Pumps.

Barrel pumps are essentially the pumps for orchard and field work. They are much more powerful than those described above, and are suitable for mounting on barrels and tanks. Very few of these, I regret to say, are as yet stocked in the Colony. Two good patterns by the Deming Co. I have seen at Messrs. Wilkinson and Co.'s, and at Messrs. Henwood, Soutter, and Co.'s, Durban, the excellent "Nixon" pump, of varying strengths, is obtainable. For orchard work these pumps need mounting upon a 50-gallon barrel, and provided with two goods lengths of hose, so that when drawn either upon a cart or sledge between the rows of trees those upon either side may be sprayed. This same contrivance can also be used for spraying potatoes for blight, or turnips for aphis, a boy walking behind the cart and directing the spray from either or both hoses. Barrel pumps can also be fixed to specially made contrivances (*See Plate VI.*), for spraying a number of rows of potatoes at once, but in these cases the pump must be strong and capable of keeping up a continuous pressure on each vent. Elaborate machinery for spraying upon a large scale is in use in the United States, including outfits worked by steam power. Nothing quite so elaborate as these will possibly be required in Natal for some time, but should the spraying of autumn potatoes prove to pay, I have no doubt that labour-saving machinery will be required.

Care of Pumps.

A well cared for spray pump, like a well cared animal, will always repay the attention bestowed upon it. If the pump is looked after properly, it will have a much longer life than if thrown aside carelessly when the day's work is done, or left to rot in the veld with the rest of the farm implements. Having finished the day's spraying, the pump should be well cleaned up, plenty of water, hot by preference, being driven through it to remove any matter which may be in the body of the pump or in the hose. After this the working parts should be well oiled, and the machine put away ready for use when next required.

LIQUID INSECTICIDES AND FUNGICIDES.

So far as insects are concerned, the various washes and mixtures, applied for their destruction, in a liquid form, are designed to kill, either by entering the stomach and causing death by poisoning, by clogging the breathing pores of the insect, or by penetrating through these and the body-wall into the tissues and killing by contact. Where insects are to be destroyed by insecticides entering the stomach and causing death by poisoning, they must be applied to those plants upon which the insects feed, and consequently can only be used for such insects as caterpillars and others which chew their food. The second group of insecticides is designed for the destruction of kinds which do not masticate their food, but which feed upon the juices of plants without eating the external portions. These are suctorial insects, and the group is well known on account of its many representatives among the scale insects and aphides.

The application of fungicides is purely of a preventive character. Fungi are parasitic plants living at the expense of their hosts, and in the case of many kinds, once they have entered the tissue of the host it is difficult to destroy them. By studying the natural history

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of these blights, however, we learn the most suitable stage for attacking them. This has been found to be when they are in the seed or spore state, and before they have entered the tissue of the host plant. Several substances which will destroy these spores are known, and they and their combinations are applied to the trees or plants to prevent the germination of the spores, or to kill them when they do germinate.

In the application of insecticides and fungicides to various plants their strength is controlled by the power of the particular plant to withstand the effect of the application up to certain strengths. Thus it comes about that much stronger applications can be applied to one plant than another, and that in winter dormant deciduous trees can be treated with stronger solutions and mixtures; the trunk, limb, twigs, and dormant buds being naturally more hardy than the green foliage and new growth.

Paraffin Emulsion.

Paraffin emulsion or kerosine emulsion, is a permanent mixture of oil and soap in solution. Paraffin itself had long been known as a valuable insecticide before this emulsion was perfected. The emulsion is now regarded as one of the most efficacious applications for plant lice and scale insects, and has been used with much success to control the mussel scale of the orange tree. Its simple preparation recommends it to most intending sprayers.

Formula.

Soap	1½ pounds.
Paraffin	5 gallons.
Water	2½ gallons.

Use common yellow soap or whale oil soap, if obtainable. Cut this up and boil until dissolved in the 2½ gallons of water. Whilst boiling add the solution to the paraffin. Then emulsify. This is better and more speedily done with a pump or syringe, when the liquid may be pumped back upon itself for 4 or 5 minutes. If a pump or syringe is not used, then the emulsion must be made with a paddle, and will take 10 to 15 minutes churning. For use this emulsion should be diluted, using nine parts of water to one of emulsion. The original emulsion, if but a little is required, may be bottled off and kept for an indefinite time. Where consistent with practice, use this wash warm.

Resin Wash.

Resin wash is used for the same purposes as paraffin emulsion, being applied to sucking insects which cannot be treated with poisons. In its action upon some insects it resembles the emulsion, killng by contact, but others it kills by forming a covering over the insect which will exclude both air and moisture from it. It is generally regarded as more efficacious than paraffin emulsion, and is preferable as a winter wash in Natal.

Formula.

Resin	24 pounds.
Caustic Soda (98 per cent.)	5 pounds.
Fish Oil (not Olive Oil)	3 pints.
Water	100 gallons.

Place the resin, soda and oil in a kettle or pot sufficiently large to hold them, then cover with water and bring to the boil. Stir the

mixture until dissolved, keeping it cooking for two hours, adding hot water when necessary, until it has acquired a dark brown colour. For immediate use add 50 gallons of hot water, and then dilute with a further 50 gallons of cold water. The liquid need not be diluted if not wanted for immediate use. For aphides use 150 gallons of water. of water.

For winter use this wash may be applied much stronger, a dilution of 65 gallons being sufficient.

Lime-Sulphur-Salt Mixture.

This is a wash which is very useful as a winter application to deciduous trees. It cannot, however, be applied to trees in foliage. It is particularly useful for controlling the White Peach Scale. It also acts as a fungicide and it useful for destroying lichenous growths upon the bark.

Formula.

Quicklime	40 pounds.
Sulphur	20 pounds.
Stock Salt	15 pounds.
Water	60 gallons.

Take 10 pounds of lime, all the sulphur, and 10 gallons of water; boil for 1½ hours, or until the sulphur is all dissolved. Slack the remaining lime in hot water and stir in the salt. When the salt is dissolved, mix the two solutions and cook half an hour longer. Strain, dilute to 60 gallons and use warm. Stir while using. Slake lime is sometimes used, but quicklime is much preferable.

Paris Green.

Unlike the paraffin emulsion, resin wash and the lime-salt-sulphur mixture, this is a preparation which kills by poisoning when taken into the system by insects with their food. It is in the form of a fine powder, and is composed of arsenious acid, acetic acid and copper oxide. It is one of the safest insecticides, because nearly all the arsenic is in an insoluble condition and therefore not liable to injure the foliage. As some trees do, however, suffer, such as the peach and other stone fruits, it is wisest to add an equal quantity of lime in making, so as to neutralise any soluble arsenic.

Formula.

Paris Green	1 pound
Lime	1 pound.
Water	200-300 gallons.

In mixing it is preferable to first make a paste of the poison, using as little water as possible, and then adding this to the water. As Paris Green is heavier than water, it must be kept well agitated whilst being applied.

Arsenic-Soda-Treacle Solution.

This is a solution greatly used in the Colony for the destruction of locusts. It can, however, be only used upon the veld, as it burns all foliage it comes in contact with. A somewhat similar solution is also used for destroying ticks upon cattle (see also page 114).

Locust Poison Formula.

Arsenic	1¼ pounds.
Caustic Soda (or washing soda)	8 ounces.
Treacle	1½ gallons.
Water	8 gallons.

Tick Wash Formula.

Soft Soap	5 pounds.
Washing Soda	8 ounces.
Arsenic	4 ounces.
Water	3 gallons.

Bordeaux Mixture.

The origin of this fungicide has already been alluded to in these notes, and nothing further need be added except tos ay that it is the safest and best all round fungicide at present known.

Formula.

Copper Sulphate	6 pounds.
Quicklime	6 pounds.
Water	40-50 gallons.

In preparing the mixture it is well to use two large casks, each having about the same capacity. If the pump is mounted on a 50-gallon barrel, then, by having two extra barrels of equal capacity, sufficient can be made to fill it twice.

The quicklime is placed in one barrel and slaked by adding hot water, and the bluestone is dissolved in the other. The best authorities recommend that the bluestone be ground up and then tied in canvas sacking and suspended in the water overnight. In general practice in the Colonies, the quicker method of dissolving in hot water obtains.

When both casks are ready, the mixture is prepared by pouring the two solutions together into the third barrel, taking care to strain it. This is conveniently managed with two equal-sized buckets.

Before starting to spray, the mixture must be tested to see that it is safe to apply. There are several means of doing this, but the one most convenient for farm use, is what is known as the knife test. A smooth, well polished steel blade is placed in the mixture for two or three minutes, and if by that time it shows a copper coloured tinge, more lime-milk must be added until the knife no longer becomes coppery.

In preparing Bordeaux Mixture some parties like to add molasses, say 1lb. to every 20 gallons, to make it more adhesive, but this is not altogether necessary. What may be done, however, where potatoes suffer from insect attack is to add Paris Green at the rate of 8 ounces to 50 gallons of mixture.

Ammonio-Carbonate of Copper.

Formula.

Carbonate of Copper	3 ounces.
Ammonia (strongest liquid)	1 quart.
Water	22 gallons.

Mix the carbonate of copper with the ammonia, and when the chemical action is finished, add the water.

ORCHARD AND NURSERY FUMIGATION.

Orchard Treatment.

Orchard fumigation, or the Hydrocyanic Acid Gas Treatment for Scale insects was brought first into regular practice in South Africa by the patient energy of the Government Entomologist of Cape Colony, Mr. Chas. P. Lounsbury. To this gentleman, in a measure, Natal also owes its present Government fumigating outfit, for, not only was this prepared under the direction of Mr. Lounsbury, but the officer in charge received his instruction in its management and use directly from him. Fumigation in this Colony dates only from the end of 1899, when the Government outfit started operations. The services of this outfit should be secured by those having a fairly large number of trees to treat. In Cape Colony outfits are co-operative affairs owned by farmers, but Natal conditions are not such as to warrant anything other than the present arrangements.

The treatment is one specially designed as a remedy for scale insects of the orange, and originates from the United States, where it was invented to meet, I understand, the attack of the Red Scale (*Aspidiotus aurantii*) more than any other. The fumigation is effected in the following manner. The trees to be gassed are covered with comparatively airtight covers and beneath these the gas is generated. Hydrocyanic acid gas is volatile, and of a highly poisonous nature indeed. The gas is produced by acting upon cyanide of potassium with sulphuric acid. An immediate reaction takes place and the poisonous fumes fill the covers and, when used at the proper strength, kills the insects without injuring the trees.

The equipment for orchard fumigation consists of various sized covers in the form of sheets for the large trees, tents for trees from 5ft. to 13ft. in height, and for very small trees a cover mounted upon a wooden framework. In using the sheets, poles or uprights are needed for hoisting them over the trees. The necessary chemicals are cyanide of potassium (98 per cent.) and commercial sulphuric acid. Few other necessaries are needed, except leaden or chinaware dishes for generating, scales and weights for weighing the cyanide, glass measures for the acid and water, and a lantern, some buckets, and spades.

Covers, etc.

The details for the construction of covers and poles have been nicely set out by Mr. Lounsbury, and those who may desire to manufacture these for themselves are referred to his notes at the end of this chapter. As a rule, however, most parties will prefer to purchase these ready made. A Durban firm, Messrs. Dobbin and Jamieson, 150, West Street, supply covers of 10oz. duck at the following prices:—Size I., £1 10s.; Size II., £2 10s.; Size III., £3 10s.; Size IV., £5 5s.; Size V., £6 10s.

In Capetown covers are supplied by Messrs. James Robertson and Co., Plein Street, their charges being:—For Size 1., to cover 5ft. trees, £1 5s. 6d.; Size II., for 6½ft. trees, £2 1s. 6d.; Size III., for 9ft. trees, £3 8s.; Size IV., for 12ft. trees, £5 2s.; Size V., for 13ft. trees, £6 1s. 6d.; for a 33ft. sheet to cover 13ft. trees, £7 7s. 6d.; for a 39ft. sheet, to cover 15ft. trees, £10 1s. 6d.; for a 48ft. sheet, to cover 18ft. trees, £14 10s. 6d.. A larger 57ft. cover is supplied at £20 2s. 6d.

Covers on a wooden frame-work are preferably made at home.

The wood should be light, and the covers of oiled calico. They should be made like a box, minus the bottom; their cubic contents are easily calculated, and the same dose used under them, without regard to the size of the tree.

CHEMICALS.—The Cyanide of Potassium is imported by the Department of Agriculture, and parties wishing to do their own fumigation are supplied at 1s. 3d. per lb. Commercial Sulphuric Acid is supplied by wholesale chemists locally, at 17s. 6d. the stone jar of 2 gallons.

GENERATING VESSELS.—In general practice small pudding bowls of chinaware will give sufficient satisfaction. If a lot of work is to be done leaden vessels are recommended.

WEIGHTS AND MEASURES.—For weighing out cyanide scales, such as a letter balance, with weights from ¼oz. upwards, are required; these should have glass or china covers for the brass trays in order to protect them from the corrosive action of the cyanide.

PROCEDURE.

In fumigating one has to observe certain conditions, and among the first of importance is the absence of sunlight whilst the work is in progress. Fumigation in the sunlight results in injury to the foliage of the tree. Why this is so has, perhaps, not been sufficiently accounted for; it is enough that it is so and, in consequence, it is only possible to fumigate either at night or on cool, dull days. The work can, however, be carried on at any time of the year, the preference being given, if to any season, to autumn.

A tree having been covered, the gas is generated beneath it by acting on the cyanide of potassium in the presence of water with sulphuric acid. A sufficient quantity of cyanide has first been carefully weighed off and put into a bowl; the edge of the tent is now lifted by an assistant and the bowl placed well under the cover near the trunk of the tree; the required amount of water is then poured on the cyanide and then the acid; the latter being poured into the bowl carefully to avoid splashing. Directly this is accomplished the operator immediately withdraws, taking extreme care to avoid inhaling a breath of the poisonous fumes, the edge of the tent is lowered and some soil placed around it to prevent the possible escape of gas. The cover is not taken off the tree until at least half an hour has elapsed in the case of a small tree, or three-quarters in the case of a large tree. Before the cover is removed the generating bowl should always be taken away, the residue buried in the soil and the vessel washed for further use. If the cover be pulled off with the bowl still in place, the latter is likely to be upset and the chances of the cover being burnt by its contents are many.

In weighing off the cyanide attention must be given to the sizes of the pieces used. They should be about the size of loaf sugar. If it is in a dust form the chemical reaction is very quick and violent. This is not desirable; the slower reaction given by use of lumps being preferable. Care must also be taken that the latter are not too large, for, when this is the case, the action of the acid is delayed or quite prevented by the formation of a brownish or black coating on the cyanide. This excludes the acid and prevents further decomposition.

Some operators mix water and acid together, in the proper proportions, before using, and pour the combination on the cyanide. If this plan is adopted it is well to remember that the acid must be

Tents for Covering Citrus Trees preparatory to Fumigating.

poured into the water and not the water into the acid, and also that the mixture must be used before it has parted with all the heat generated on mixing it with the water, otherwise it will be found to have lost its virtues.

Quantities of Chemicals.

The following table of quantities is that designed in Cape Colony for use with the unoiled duck covers recommended above. In framing it, the area of the surface through which the gas may escape and the cubic contents were both considered. Less chemicals by one-fourth, or even one-third, may be taken for trees under 14ft., if heavily oiled covers are employed, or if the trees are scantily foliaged and not badly infested with the scale; but, except when the trees are found to suffer severely, it is suggested that the quantities below be used.

Height.	Diameter.	Water.	Acid.	Cyanide.	Space Enclosed.
Feet.	Feet.	Fluid. oz.	Fluid. oz.	Oz.	Cubic Feet.
4	3	½	½	¼	(25)
6	4	1	½	½	(65)
6	6	2	1	1	(140)
8	6	3	1½	1½	(200)
10	8	5	2½	2½	(435)
12	8	6	3	3	(535)
12	10	7	3½	3½	(815)
14	10	8	4	4	(970)
14	12	10	5	5	(1,355)
16	12	12	6	6	(1,585)
16	14	15	7½	7½	(2,105)
18	14	16	8	8	(2,415)
18	16	20	10	10	(3,085)
20	16	22	11	11	(3,485)
20	18	26	13	13	(4,325)
22	18	30	15	15	(4,835)
24	20	40	20	20	(6,500)

Axioms.

Cyanide of Potassium and Sulphuric Acid are highly poisonous hemicals and should be kept under lock and key, and labelled "Poison."

The poisonous action of Cyanide and Hydrocyanic Acid Gas is he same; a taste of one (one-one hundred and seventy-fifth of an unce) or a breath of the other will probably prove fatal.

Hands and nails must be cleaned after using to avoid taking yanide into the system later when eating.

Sulphuric Acid or Oil of Vitriol burns almost everything it comes n contact with and when diluted with water will burn the hands, lothes and covers.

Cyanide decomposes rapidly if left exposed to the moisture of the atmosphere. It must, therefore, be kept in airtight boxes or tins. Covers must be free from holes and fairly airtight.

Details of Construction of Outfit.*

"The tent covers are made dome-shaped, the top being curved like the surface of a hemisphere. Eight to ten ounce American ducks are used for unoiled covers, and a lighter drill for tanned or oiled covers. The narrow width material of 27 inches has been found the most economical in use. When this width of cloth is used, the proper curve of the tent may be obtained by cutting the cloth on the line of an arc drawn from the middle of the end of the breadth to the point on either side, distant one-fourth of the circumference of the completed tent, and passing through a third point 3½ inches out from the straight line connecting the first points. Board models of the required length, 3½ inches at the middle, and curving gradually to the end, are found to be a great convenience in delineating the curves.

"The crowns of the tent are reinforced both inside and out with extra pieces of cloth, and rope loops are attached to the crowns both inside and out for convenience in handling the tents.

"The tents in use are of four sizes:—I., made of six breadths, 2¼ yards in length; II., of 9 breadths, 3 yards in length; III., of 11 breadths. 4 yards in length; and IV., of 13 breadths, 5½ yards in length. The breadths in all cases are 27 inches in width.

"A circle of gaspipe is used to keep the mouth of each tent expanded. The circle is made in halves; the ends are joined by short pieces of larger pipe into which they slip and are held in place by loosely-fitting bolts passing through holes drilled through both the end of the circle and the short connecting piece. Before the ends are connected the halves are attached to the tent by passing them through loops sewn to the tent about one foot from the bottom. These loops fit loosely. On all but the smallest tents, one is attached to each seam, the smallest tents have three to each two breadths.

"A stout pole ending in a U-shaped iron rest is used to support the crowns of the larger tents in placing them over and in removing them from the trees; the rest is hooked in the rope loops.

The Sheets.

"The sheets are made in the form of a regular octagon. They are six in number and vary from 32 to 48 feet across. Widths of cloth from 27 inches to 10 feet were used in the construction of different sheets, but it was found most economical to use the narrowest width, the additional expense for sewing being less than the relatively greater value of the cloth. Ten-ounce duck was used for the middle breadths of equal length, and eight-ounce duck for the breadths outside of these. It is not believed that the heavier cloth added sufficient to the strength to make its use desirable. and eight-ounce duck throughout might be employed.

"In cutting the cloth to secure the octagonal shape, little trouble will be experienced if it is remembered that one side of a regular

* The following details are quoted almost literally from the Report of the Government Entomologist of Cape Colony to the Horticultural Board on "Gas Treatment of Scale Insects," Capetown, June, 1897.

raising the sheet, is attached to the movable pulley. This arrangement is superior to hitching the pulley-hook to a ring or loop sewed to the sheet, as the resulting strain when the sheet is raised is far less on the cloth. (See Plate X.)

"To use the uprights, one is laid at either side and the sheet dropped behind the tree; the hitch is then made and the tackle attached. The four men then raise the poles, and when these are vertical, two of the operators steady them by means of the guy ropes, while the other two raise the sheet by pulling on the tackle. When raised sufficiently (see illustration), the poles are allowed to drop slowly forward, thus bringing the sheet over the tree and in position."

Nursery Treatment.

There is not much explanation needed in connection with the use of Hydrocyanic Acid Gas in nurseries. The first requirement is a room or chamber of some sort which can be made airtight. This may be constructed of bricks, wood or iron, and but little ingenuity is required to make it airtight. The mode of procedure is much the same as in an orchard and can be modified to suit the fancies of the operator. Thus at the Botanic Gardens, Durban, the acid and water are placed in a basin on the floor and the cyanide in a thin paper bag suspended above by a string, which can be lowered into the dish from the outside. There are many other "ideas," but this is simple and practical.

The dose for the room is calculated upon the basis of 1 to 1½ ounces of cyanide to 200 cubic feet.

Cyanide is sold to nurserymen at 1s. 3d. per lb.

* * * * *

PART III.

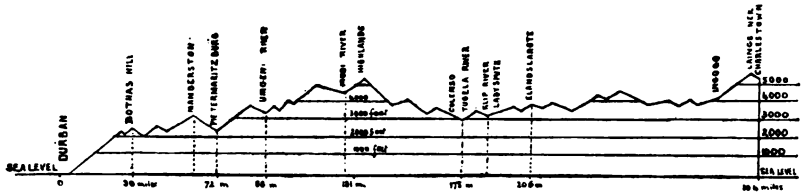
INTRODUCTORY.

As intimated in my letter of submittal; this part of my report has been prepared to supply an evident want among an intelligent and, for the most part, reading, agrarian population.

Hitherto practically nothing has been published upon the insect and fungus pests of Natal and so, apart from other considerations, the present is a fitting opportunity to take some notice of them.

Very many of the pests referred to in the following notes are introductions from abroad and are consequently well known to entomologists. Few of these have, of course, been properly studied under Natal conditions, but in each case an effort has been made to give as much local experience concerning them as it has been possible to acquire during the nineteen months preceding the publication of this report. Such statements must naturally be taken as generalisations; for, owing to the want of uniformity of soils (even upon individual farms), and also to the variations of climates (due to the rapidity with which the country rises in irregular configurations from the coast to the berg), what applies to one farm may not apply to another, perhaps but a few miles off.

The peculiar undulations and rise of the country is well illustrated, for those unacquainted with the "Garden Colony of South Africa," by the accompanying chart of the elevations of the main railway running through the greatest length of the Colony.



ENTOMOLOGY.

Entomology is the science or study of insects. Its pursuit teaches us to understand the relations which these small animals have to one another, and the parts they play in the economy of Nature. It is a study which possesses a peculiar interest to the agriculturist, for it is only by the possession of a thorough knowledge of the natural history of the noxious species that he is able to deal effectively with them and, at the same time, to appreciate the work done by those which prey upon the destructive sorts, and so benefit him.

The word insect is derived from the Latin and is expressive of the characteristic parts or segments, of which the body of an insect is built up. Correctly speaking, the term is only applied to those segmented animals which, in the adult stage, have six legs and the body deeply incised twice, so that it is seen in three well-defined regions.. Agricultural Entomology, however, is bound to acknowledge as insects, animals which are really but near relations. These are the spiders, scorpions, ticks and the millepedes and centipedes. A step further is also necessary if we are to include sow bugs and land crabs.

The differences between the various groups are easily recognised.

Take the group which contains the spiders, scorpions and tick, and it will be seen that they differ essentially from insects in having eight legs and not six, whilst their bodies are not divided into three regions.

Then the millepedes and centipedes are easily outclassed by the superabundance of legs which they possess. Sow bugs and crabs are more distant relations again, for they belong to a group of animals possessing many characteristics in common with insects, but are mostly acquatic in habit and, instead of owning one pair of antennæ, have two pair. For the purpose of these notes, it will be sufficient to treat of the natural history and relationship of insects alone.

A knowledge of the internal anatomy of an insect is not greatly appreciated by the practical farmer, but it is as well to point out some of the features of the organs which lie hidden within the horny-bodied creatures we so often crush under foot. In the first place insects have a brain and a nervous system—not so elaborate as our own, but still fulfilling somewhat similar functions. They also have a peculiar tubular heart, lying beneath the length of the back. This, again, is much simpler than ours, being without any extraordinary arterial system; for the colourless blood is pumped through it from the posterior end of the body towards the head, where it escapes into the body again, bathing the tissues and absorbing air from the multitude of air pipes with which it comes in contact. Their breathing, again, is quite dissimilar to ours, for the air enters the body through a number of small openings, varying in number, and spoken of as spiracles, a couple of which are found on most segments of the abdomen and upon the thorax. This feature has a very important bearing upon the treatment of certain destructive kinds.

The digestive organs of insects have a resemblance to those of other animals, and are modified in accordance with the diet of the different species. Sexual functions are alone exercised by adult insects, and some kinds are remarkable for the power females have of producing young, for a certain number of generations, without the intervention of the male sex. This peculiar function is known as *Parthenogenesis* and is particularly common among the aphides.

Considered externally, an insect is first interesting because of the fact that its skin is its skeleton. There is no bony framework upon which the muscles, tissues and organs are draped and hung, as in the case of the vertebrates, or back-boned animals; but its place is supplied by this horny skin, or "Exo-skeleton." This helps to account for the segmentation alluded to above, for were this skeleton unsegmented or unjointed, our insect would make but little progress through life. The fact that an adult or sexually mature insect has the body twice deeply incised, has already been commented upon. Naturally the head is the most complex structure of the three regions into which it is thus divided, for here we find the mouth, the eyes and the antennæ. All insects have two antennæ, or, as they are popularly called, "feelers." They are organs made up of a series of joints, and are always placed between the eyes. They are supposed to correspond with the ears of higher animals, and without doubt they are organs often possessing sensitiveness of the highest degree. Insects possess no regulation organs like ears to hear with and nostrils to smell with, and so the exercising of these senses is generally recognised as part of the functions of the antennæ. In the matter of eyes the adult insects are particularly well provided for. They appear to have two, but these are very large and fixed so

that they cannot be rolled from side to side. The absence of this power is amply compensated for, however, by the fact that each of these eyes is not one eye but many, consisting as it does of a huge number of small eyes, whose facets face in every direction. These small eyelets are called "ocelli," and in many cases Nature, doubting whether she has supplied a sufficiency, often places three extra ones upon the crown of the head. In many immature insects the remarkable compound eye does not exist, but if the insect be not blind, their place is taken by small "ocelli," similar to those found upon the head of an adult.

The mouths of insects vary in their designs considerably, but as their structure will have to be considered later, this point may be passed over for the present. The thorax is the next important part of an adult insect's anatomy, for to it are attached the legs and, should the species be possessed of them, the wings.

The legs are always six in number, though sometimes some may be so modified as to be quite useless. They are jointed, and the terminology of the different parts is very approximate to that we apply in speaking of the legs of higher animals. The wings may be two or four, but never more, and they vary considerably in structure.

The abdomen is the third region. It has no particular appendages and is made up of a varying number of rings or segments, the sexual organs always being found in the region of the last.

Passing to the natural history of insects, or the different phases of their life cycles, we find that, with few exceptions, all are produced from eggs. The exceptions are those which are born alive, the eggs having been hatched within the maternal abdomen, as is the case with many flies, or those which are born of their mother, as the aphides or plant lice. There is a prevailing idea among many farmers that insects—particularly the harmful ones—are spontaneously generated in decaying matter, or that they spring from the plant they infest. This is, however, never so; not even in the case of the Turnip Aphis.

Subsequent to the egg stage, all insects go through very remarkable changes in form during the courses of their existence, and these changes are quite as often accompanied by equally remarkable changes of habits and propensities. What more apt illustration do we want of this than the blue Peach Moth, which, as caterpillar, feeds upon the leaves of the *Sapindus* tree and, as a moth, pumps up the juice from our mangoes and our peaches.

Whether these changes be great or small, three distinct periods are always to be recognised; and the most remarkable transformations occur in the case of caterpillars, grubs and maggots, for from such may come butterflies, moths, beetles and flies. Locusts, plant bugs and aphides do not go through such marked changes, still there are three periods of growth. These three periods in the case of the former group of insects are spoken of as the larva, the pupa or chrysalis, and the imago or adult. The same terms apply to the second group, except that the intermediate stage is called the nymph stage, and not the pupa or chrysalis stage. It is well to point out here that, as among the higher animals, so among insects, like always produces like. Thus the egg of a moth always becomes a moth, that of a beetle a beetle, and so on. In no case either does a beetle ever change to a moth or a moth to a bug, or vice versa, as is so often thought by many who have given the subject little attention.

It is whilst as a larva that an insect feeds the most and makes the most rapid growth. As compared with our own, for instance, the hard,

horny skin modifies the method of growth considerably, for, as can be easily realised, a limit to the elasticity of this epidermis must soon be reached. This circumscribed state of affairs is overcome by a complete casting off of the tight-fitting jacket and the acquisition of one more accommodating. This shedding of the skin is known as "moulting," and every insect moults a number of times during the early stages of its existence. Now, were we to study the natural history of either a caterpillar, a grub or a maggot, subsequent to its hatching from the egg, we would easily observe these moults, and for a time there would be no material change in the animal's form, except the rapid increase in size and perhaps some modification of colour. There is, however, a limit to this period, which is attained when the insect, having eaten to repletion, prepares for a moult which will change its form and habit entirely. In anticipation of this change elaborate preparations are often made; cocoons being spun of silken threads, or built up with the aid of sticks, leaves, or clay in some retired or inconspicuous spot; and those insects which do not take these precautions will hide in a crevice or bury in the soil.

Now, instead of an active, feeding creature, we have a corpse-like substitute. This is called the pupa, another word derived from the Latin, and applied to this stage because, in the case of moths, it was thought to have a resemblance to a baby wrapped up in clothes. This period of death-like trance may be short or long, according to the habits of the particular species. By another moult or casting of the skin the third period of existence is entered upon. The whole appearance now is changed entirely from what it has been previously, and often also the habits and performances. In entering this period the insect becomes sexually mature, often possessing wings and such organs as have already been described above in speaking of the external anatomy. If instead of a caterpillar, a grub or a maggot, either a plant bug or a locust had been selected for study, during the varying periods of its existence, such startling transformations would not have been observed; for with these the second period is not in such sharp contrast to the first or the third.

The last moult of a Locust, from nymph to adult (*after Riley*).

Take for example the natural history of the locust so well known in Natal. It emerges from the egg a small, dark hopper, destitute of wings, but still bearing a strong family resemblance to its parents. The little hopper soon begins to feed and grow rapidly, casting one skin after another to accommodate its fast increasing size. The second

period of its growth is marked by the appearance of small pads upon the back and these gradually, with each casting of the skin, increase in size until they reach half-way down the back. These pads are immediately recognised as the immature wings. Then comes a final moult and the insect enters into its third stage of existence as an adult locust, furnished with ample wings and the power of flight. Were we to have studied a plant bug and many an aphis, exactly the same conditions of growth would have been observed.

CLASSIFICATION OF INSECTS.

At this point it becomes essential for the completeness of these remarks to discuss the arrangement of insects according to the relationship they bear to one another. This is called the classification of insects into natural orders. Altogether there are some thirteen orders or groups into which we can class the insects which come under our observation about the farm and garden. These natural orders have been arranged and re-arranged by scientists in what they have considered their natural sequence, but for our purpose it will be sufficient to briefly consider them rather with a regard for convenience than for correctness.

Order I.—Butterflies and Moths (*Lepidoptera*).

This order has been placed first, because its members are undoubtedly the most prominent and best known to all. They are characterised by having four wings, which are clothed with minute scales, giving them a velvety appearance. They, as a rule, also have the mouths in the form of a long sucking tongue, which is carried coiled up beneath the head. The adults lay eggs from which caterpillars hatch. These caterpillars have six horny, jointed legs attached to the three foremost segments of the body and usually two or four other sucker-feet upon the hinder segments. The tail end of the body takes the form of a clasping, sucker-like foot. The mouths of the caterpillars are suited for gnawing. The caterpillars pupate, the pupæ being found in cocoons, or naked in the soil, or attached to the food plant. Examples: Lucerne butterfly, fruit moth, etc.

Order II.—Beetles (*Coleoptera*).

In this order the members have two pairs of wings, but the upper pair is of a horny nature and together form a sheath to cover the second pair, which are membraneous, and used for flight. The young of beetles hatch from eggs, and are generally recognised as grubs. Their mouths are fitted for gnawing and they usually possess six legs, though in many cases the grubs of beetles are legless. Like butterflies and moths, they pupate and go through several transformations, the pupa stage being usually spent in the ground and sometimes in an exposed position. Examples: Coffee borer, grain weevil, etc.

Order III.—Flies (*Diptera*).

These insects have but two glassy wings, behind each of which is to be found a small poiser or balancer. Their mouths are fitted for sucking and some for piercing as well, and at times the mouth is wanting altogether. The young are born from eggs or produced alive, the eggs having hatched in the abdomen of the maternal insect. They are known as maggots and are legless. They pupate usually in the soil. No cocoon is spun, but the skin of the maggot contracts and hardens and so form a puparium. Examples The housefly, mosquito, tsetse fly and maggot fly.

Order IV.—Fleas (*Siphonaptera*).

These insects are often classified as flies. They are virtually wingless, but have two minute scales upon the body representing wings. Their mouths are fitted for piercing and sucking. The young are elongated, footless maggots. They pupate and so have a complete transformation. Examples: The jigger flea, dog flea and house flea.

Order V.—Bees, Wasps and Ants (*Hymenoptera*).

The insects of this order are recognised by their four transparent wings. Their mouths are usually fitted for sucking and biting. The young hatch from eggs laid by the adults. Like the young of the two-winged flies, they are, as a rule, legless maggots, but in one group, the sawflies (not much represented in Natal), the young often resemble the caterpillar of a moth or a butterfly. They pupate and have a complete transformation. Examples: The honey bee, house ant, etc.

Order VI.—The Dragon Flies (*Neuroptera*).

These insects are of a well-known form. They have four wings, usually of a transparent, glassy nature, which are characterised by a great network of veins. The young hatch from eggs, and they go through a complete transformation. Examples: The dragon-fly and the white ant.

Order VII.—Locusts, Grasshoppers, Crickets, etc. (*Orthoptera*).

These are insects having four wings. The first pair act as sheaths for the second pair, and the insects are characterised by these latter wings being folded lengthwise and straight. The young hatch from eggs and have a general resemblance to their parents. They never enter a resting or pupa stage and so do not undergo complete transformations. Examples: The plague locust, totofianas, house cricket, etc.

Order VIII.—Plant Bugs, Scale-Insects, Aphides, etc. (*Hemiptera*).

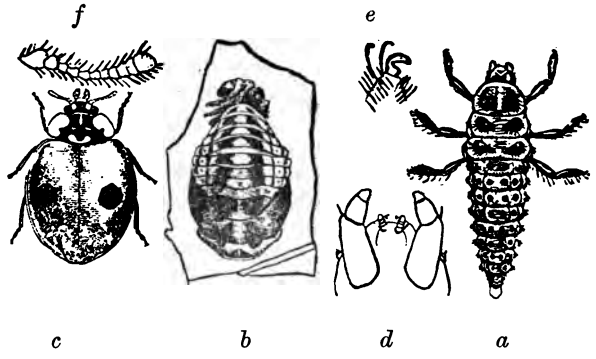
These insects are divided into two groups. In one we have the plant bugs; these are characterised by having four wings, the basal half of the upper pair being horny, and the extremity membraneous and like the hinder wings. The mouth of a plant bug is especially adapted for piercing and sucking. The young hatch from eggs and resemble the parents, and have no complete transformations. Examples: Coffee-bug, orange-bug and bed-bug. In the second group we have the scale-insects and aphides; they are similar to the bugs, but have the first pair of wings membraneous and of the same nature throughout. Examples: Red-scale and mussel-scale of the orange, turnip-aphis and woolly-aphis.

Order IX.—Thrips (*Thysanoptera*).

Four-winged insects of minute size. The wings are extremely narrow and have a fringe around them. They are supposed to both bite and to suck with their mouths, which appear adapted to suit either purpose. The young hatch from eggs and resemble the adults except that they are wingless and do not pupate. Example: Onion-thrips.

INSECT FRIENDS.

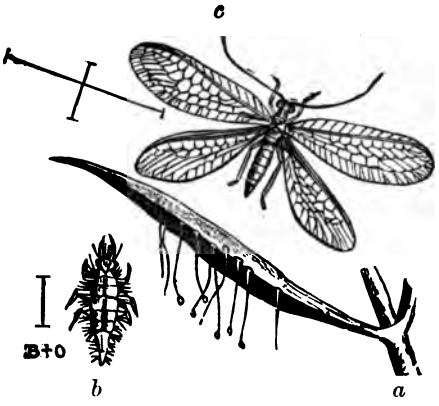
Before passing to the discussion of pests, which follows, it is as ell to draw attention to the number of insects which act towards us, agriculturists, in a beneficial manner by destroying destructive ecies. Apart from these there are, of course, certain insects of a mmercial value, but little need be said of them here, other than that e list includes the bee, the silkworm, the cochineal insect and the c insect. There are a few others of which use is made, but not to ıy considerable extent. The number of insects which, in an indirect ay, benefit us is very large, but their work is unappreciated because ınoticed. The recent history of agriculture supplies us with many lustrations. The one remarkable case being where the small Vedalia eetle, preying upon the Australian bug, cleaned it out and so ccomplished what man could not do. The history of these two insects written largely in American and South African agricultural literaıre, and needs no further mention here. What I do wish to draw ttention to, however, are a few of the beneficial insects which I have ome across in Natal. Insects which destroy others either by preying pon them or parasitizing them. Among the most conspicuous of the rmer are the praying mantids, or "Hottentot gods," as we call ıem here. These insects live to destroy others, and the huge numbers ı which they appear about the month of March is undoubtedly llowed by the destruction of numerous insects, especially small grass-oppers. One species, a large green fellow, with a white spot on ither wing, is at this time particularly abundant, and one of ıe handsomest is *Harpax oculata*, a not altogether uncommon pecies. In the same category we also have a small moth *Thalpocares sp.*) which, in its caterpillar stage, preys upon a species f scale insect (*Ceroplastes*) found on the custard apple; and, ere it not for this moth, I fear this particular fruit would not be oted so pest-proof as it is. In many countries ladybirds—the small occinellid beetles—constitute a considerable insect destroying force. Natal, however, is not rich in ladybirds; still, I have noticed that the ecies known as *Rodolia iceryæ* does more towards keeping the ustralian bug in check than does the imported *Novius cardinalis*, etter known as the *Vedalia* beetle. *Exochomus nigromaculatus*, a pecies which flourishes in the Cape, also occurs here, but it is seldom een in any numbers. A large ladybird has been taken feeding upon



Life Stages of a Ladybird.—*a*, the larva or grub; *b*, the pupa or chrysalis; *c*, ıe ladybird or mature beetle; *d*, the mouth parts of the grub; *e*, claw of the rub; *f*, antenna of beetle. (Block loaned by C. P. Lounsbury.)

the white scale of the peach (*Diaspis amygdali*), and this may yet prove of considerable importance. Perhaps the most interesting case which came under my observation was that of the ladybird *Stictolæis instabilis*, Muls., a variety of *S. 22. maculata*, Fabr., feeding upon the larvæ of the beetle *Galerucella triloba*, Fabr. The latter insect was in great numbers last spring upon a number of native shade trees (*Celtis Kraussiana*, Bernh.) in Durban, but the ladybirds became so numerous that the *Gelerucella* was prevented from defoliating the trees altogether.

A further case of interest which came under my notice was in connection with the cetonid beetle *Macroma cognata*, which I have taken feeding upon mealy bugs. Subsequently I learned from Mr. Brickhill, near Phœnix, that he had seen the same beetle eating the common soft scale (*Lecanium hesperidum*). The peculiar point of interest regarding this beetle is that it belongs to a family only too notorious in the Colony for the manner in which its members destroy both flowers and fruit, and for this to have developed such abnormal tastes is very remarkable.



The Aphis Lion or Lace-wing fly which feeds upon scale insects, aphides and psyllids.—*a*, eggs attached on stalks to a leaf; *b*, the larva or Aphis Lion; *c*, the adult or Lace-wing fly. (From Miss Ormerod's South African Insets; block loaned by C. P. Lounsbury.)

Other than these predacious insects we have those of a parasitic nature. Parasitic insects are usually either wasps or flies, and I regret to say that, so far, there are very few to take much account of, so far as our agricultural interests are concerned. Among the wasps is one species, a minute black insect, which occasionally destroys a number of mealie worms, but as it takes thirty or more to kill one worm, I fear that we can never reckon them as of much moment. Another small wasp is parasitic upon a form of brown scale, which is common upon native figs, and undoubtedly keeps this insect in check. I have also reared a minute parasitic wasp from the eggs of what I call the Natal Codling Moth (*Carpocapsa sp.*)* Among the flies which are parasitic upon other insects I have only to mention a species of *Tachina*, which destroys numbers of the wattle bag-worm. Recently reports have reached us that a species of this group of flies is destroying large swarms of locusts in Cape Colony and it is with regret that one has to remark that they have not made their appearance in Natal. The introduction of some should be quite feasible.

*This has since been determined by Dr. L. O. Howard as *Trichogramma pretiosa*, Riley.

BUTTERFLIES AND MOTHS.

ORDER Lepidoptera.

Butterflies and moths constitute the most popular and best known group of insects; for among their numbers are to be found some of the handsomest and most graceful, and, at the same time, some of the most destructive. This latter remark applies more particularly to the moths, for comparatively few of the sunshine-loving butterflies are guilty of much damage. The chief characteristics of the order have already been alluded to and it is not necessary to enlarge very much upon them here. Speaking generally, moths, in contradistinction to butterflies, are night flyers, preferring to hide away during the day. The members of the two sections may be easily recognised by the farmer on comparing the form of the antennæ or feelers; for those of the butterflies are slender and thread-like, with knobs at the tips, whilst in the case of the moths—though these organs vary considerably in structure—they are never knobbed. Furthermore, butterflies and moths may be distinguished apart by the manner in which they hold their wings when at rest; the former holding them in a vertical position, whilst the moths fold their wings horizontally or wrap them around the body.

In this report I have only had occasion to allude to one butterfly as destructive, this being that of the Lucerne Caterpillar, *Colias electra*; but mention might also have been made of the Orange Butterfly, *Papilio demoleus*, as well. Apart from the destructive moths described in detail, the occurrence of the following may also be noted:—

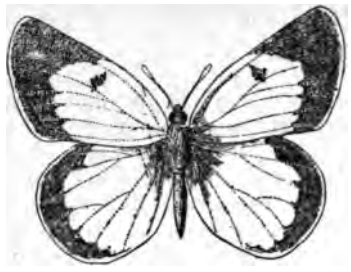
The Mealie-cob Worm, *Heliothris armigera*.
The Larger Bees-wax Moth, *Galleria melonella*.
The Clothes Moth, *Tinea pellionella*.
The Oak Cup-Moth, *Parasa amœna*, Feld.
The Lily Caterpillars, *Diaphone dominica*, Cram., *D. enumela*, Stol. and *Dipcade irride*, Fonch.
The Death's Head Hawk Moth, *Acherontia atropos*.
The Oleander Hawk Moth, *Chaerocampa nerii*.
The Grape Hawk Moth, *Chaerocampa celerio*.

THE LUCERNE CATERPILLAR.

Colias electra, Linn.

Not a few complaints have been addressed to me from different farmers with regard to this pest, which may easily ruin a field of lucerne, if allowed to, and often seriously interferes with the growth of young plants not long from the seed.

The caterpillars, when full grown, are of a green colour, much resembling that of the lucerne itself, and are characterised by a conspicuous white stripe running along each side of the body, and a dark green streak along the centre of the back. They pupate, as do the larvæ of most butterflies, in an exposed position upon the leaf or stem, the chrysalis hanging naked and supported only by the tail and perhaps a thread or two passing over the back. These chrysalides are a pale green yellow with several dark streaks. After pupating some four to five days, the adult butterfly emerges. This insect is not an uncommon one about our fields, and may be recognised by the bright orange-yellow colour of the wings, which are bordered with black. The



Butterfly or adult of the Lucerne Caterpillar.

female butterflies can be seen at any sunny hour flitting over the lucerne, and often resting awhile to deposit their eggs.

These, as far as my observations go, are always placed upon the upper surface of the top leaves of a plant. They measure one-twentyfourth of an inch in length and less than half that in width. They are somewhat egg-shaped and stand upon end, the apex being pointed, and the base joined to the leaf by a short stalk. They are fluted faintly from base to apex. As a rule, the eggs hatch upon the second or third day after laying.

Remedies.

I have said that this pest will destroy a field if allowed to; this, however, seldom occurs, as our lucerne fields are so small that, when the caterpillars are too numerous in them, they are usually pastured off at once. It sometimes happens that the lucerne is attacked when it is very young, and small areas might then be effectively treated with Baris green, say 1lb. to 150 gallons of water, or with paraffin emulsion, both, of course, being applied with a spray pump.

THE MEALIE GRUB.

Sesamia fusca, Hmpsn.

Upon the whole, the raising of mealies, as Indian corn is called locally, is one of the most successful branches of agricultural farming in Natal, the country from coast to berg yielding good crops. The cultivation of the cereal varies with the man. Kafirs cultivate it in a multitude of small lots, coolie cultivations are growing quite extensive and most farmers boast their 50 or 100 to 300 acres. Many farmers in Natal are little ahead of their coloured competitors in the matter of cultivation, whilst that of others, again, is a credit to any land. One practice is, however, universal, and that is husking in the field, and leaving the mealie stalks standing on through the winter. I cannot cavil at this practice, for it is considered a correct principle, but I wish to point out that it is these standing mealie sticks—left as winter feed for the cattle—which account for the prevalence of the mealie grub, the pest most felt by the mealie grower.

This insect is common throughout most parts of the Colony, being, if anywhere, at its worst in the Midlands. The nature of its damage is almost too well known to need recapitulating. Briefly: a field of young mealies shows much promise of growth when suddenly one is made cognisant of the fact that it has been "struck" by the grub. This is unmistakeably indicated by the wilting and death of the terminal leaves, consequent upon the eating out of the core of the young plant by the grub and without exertion the dead portion may be withdrawn from the tubular sheath formed by the untouched bases of the outer leaves. (*See Plate XI., figs. 1 and 2*).

A certain percentage of loss from this insect can be looked to in all fields, but in order to convey some idea of its capabilities I may mention cases where I have seen almost every plant destroyed, whilst

50 to 60 per cent. of plants, after hoeing out, is not uncommon. It is, of course, the stage of growth at which the grub attacks the plant which accounts for the irretrievable mischief done.

The Mealie Grub is the caterpillar of a Noctuid moth, and very similar in its habits to the Larger Cornstalk Borer (*Diatrea saccharalis*, Fab.) of North America.

Natural History.

The eggs deposited by the moth of the "mealie grub" I have not been successful in observing, but I take it that those of the first brood are laid upon the plants soon after the young corn comes up through the ground. After hatching the young apparently live for some time between the leaf sheaths before penetrating into the heart of the plant. When the grub is from one half to three parts grown, it has usually completed its mischief and may be found working up and down in the core of the plant, usually boring one or several holes to the outer surface of the stalk, through which the excrement is often thrown, or which are to provide means of exit for the adult. The pupa, as may be inferred from the foregoing sentence, is found in the stalk and not, as is usually supposed by farmers, in the soil.

There are two broods of caterpillars in a season when circumstances are favourable, the first coming to maturity early in February.

The moths of this first brood are not long on the wing when they begin depositing their eggs upon the maturing mealies. The second brood, owing to the advanced state of the mealie plant, is not capable of doing the damage of the first, but there have been cases where crops of ensilage mealies have been ruined by it, and in one instance I found upon an average ten caterpillars to each stalk.

How this pest passes the winter I am, as yet, unable to say with certainty, but what evidence I have leads me to the belief that some pupæ remain in the mealie stalks, whilst others emerge as moths late in May and hybernate as adults.

The first egg-laying period is undoubtedly very regular and there are few farmers who cannot tell you the right time to plant mealies, in their particular district, in order to escape the "mealie grub." As illustrating this, I may quote from correspondence before me:

"What I told you re mealie planting holds good, I believe, for most of the Midland belt between places as far apart as Tugela and Umzimkulu (120 miles), along the first plateau, 1,800ft. to 2,500ft. That is to say, the grub is bad during September and October, so that mealies are planted usually only after the first week in November, often not till the end of November. Some are usually planted in August for early mealies, especially if there has been early rain."—F. F. Churchill, Hillcrest.

"We plant mealies in November so as to be free from the grub. The months of September and October are too early for this district, and mealies planted in these months suffer very much. The grub has been worse during the last two or three years, and I put it down to the dry seasons. Eight to 10 years ago, however, mealies were planted, as a rule, as early after the first rains as possible, during September, or early in October."—Fred North, Northdene.

"The proper time to sow mealies in this district is from November 25th to December 25th."—John Moon, Manderston (3,000ft).

"We find that if we plant mealies earlier than November 20th they are almost certain to be destroyed by the grub, consequently

for the last 15 or 16 years we have tried to begin sowing on November 20th."—W. Mapston, Thornville Junction (2,700ft).

"I have found that there are only two periods during which we can plant with any chance of getting a crop. Very early, during August or early in September, and later during the few weeks between November 20th and Christmas. I have often seen mealies planted at those times entirely ruined by the grub, and I suppose something in the climatic conditions upset their usual breeding time. . . . . The early planted mealies usually escape, but any planted between them and mid-November are sure to go wrong, and no one ever plants any at that time now."—John Marwick, Richmond (2,800ft.).

"It has been noticed hereabout that mealies planted in August (when we have rains as early as that) do very well, but the September and October sowings get the grub."—W. T. Woods, Mooi River (4,000 to 5,000ft.).

From these letters it will be seen that a crop sown in August is sufficiently advanced before the egg laying commences, for the caterpillars to destroy the plants, whilst plants from sowings before the middle of November are in a very susceptible stage during the egg-laying period. Thus it is that experience has taught means of escaping a pest whose depredations would otherwise cripple mealie growing in the better half of the Colony. It is evident, however, that the pest is rather upon the increase than the decline. This, it must be acknowledged, is due to that feature in cultivation to which I have already alluded and which is so favourable to its increase and I have little doubt that if, after harvesting, mealie stalks were burnt off and fall ploughing practised. the pest would be of little account, provided, of course, Kafirs also destroyed their mealie and amabele stalks.

Description.

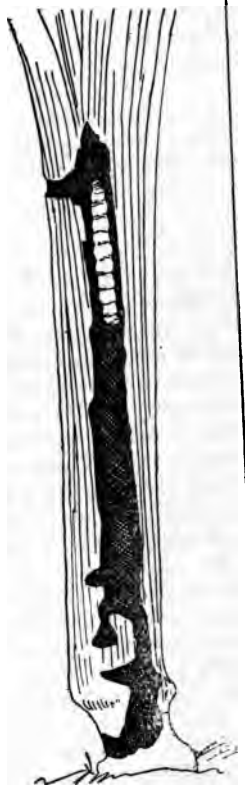
The mealie grub or caterpillar, when full-grown, measures one and three-tenths inches in length. It is of a creamy white colour, with a smoky band upon each side of the body in the region of the spiracles, which also extends across the last segment but one. The last segment is yellowish and similar in colour to the horny shield upon the first segment of the body, behind the head. The head is of a reddish colour with the apex black. Spiracles black. Upon each body segment except the last are four setiferous, smoky papillæ, the centres of which are quite black. Ventnum and prolegs white. True legs tinged with brown, more intense towards the tip. Some caterpillars are of a more smoky colour than others and some are tinged with pink.

The chrysalis is 7-tenths to 8-tenths of an inch in length, of a reddish or dark-brown colour. The abdomen ends in a pair of narrow, conical, divergent points, about one-fortieth of an inch long. Pupa in stalk of mealie, no cocoon.

The moth measures 1½ inches in the expanse of the wings, and about seven-tenths of an inch in the length of the body, and is not a conspicious insect. The fore-wings, as a rule, are of a dull, coppery brown, relieved by inconspicuous markings in the centre and a row of four or five small, black triangular spots parallel to the outer creamy yellow. The hindwings are uniform in colour, and generally of a smoky brown. The body is brown, or greyish brown, the front of the thorax being tinged with red.

PLATE XI.

1.



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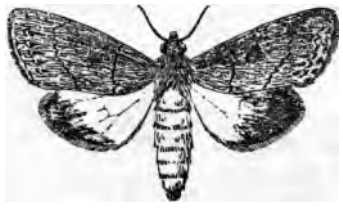

4.

Claude Fuller, del.

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Treatment.

Outside cultural operations, there is scarcely any recommendation to make. Personally, I am of the opinion that if, when hoeing out, particular attention is given to wormy plants—which should be carried out of the field and fed to the cattle—a great deal of good will result. This plan I succeeded in getting a friend to adopt in an eight to ten acre field, in parts of which 50 to 60 per cent. of the plants (after hoeing out) were found to contain grubs, and the treatment, I believe, has kept the stalks sound and strong instead of being riddled.

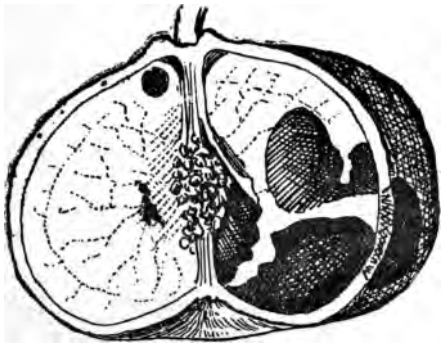
Explanation of Plate XI.—1, young mealie plant "struck" by grub (reduced); 2, interior of same, showing nature of damage; 3, the mealie grub or caterpillar; 4, moth of the mealie grub.

THE NATAL CODLING MOTH.

Carpocapsa sp.

I fear that in selecting the above name for this insect I have been rather venturesome, but it is difficult at any time to meet the craze of the practical man for a "common name" for every insect, instead of a more descriptive technical title. This insect, however, has some claims to the name applied to it for, not only does the caterpillar resemble that of the codling moth in general appearance and in the manner in which it destroys fruit, but its natural history has a great likeness to that of the world-known pest. Moreover the codling moth has long been regarded as occurring in Natal, having been reported here in 1887 by Dr. L. O. Howard. That this is the case is now much to be doubted, as a diligent search and many inquiries have not yet revealed its presence, and it is quite possible that the insect under discussion has been mistaken for it. It is, however, only right to mention that, in the Karkloof, the pears and apples were attacked in former seasons by a pest thought to be the codling moth; and this may yet prove to be the case, as the moth with which I am now dealing has not been found attacking these particular fruits. It was hoped that the point would be established this season; but, owing to the drought, the fruit fell before coming to maturity and so there was no infestation.

So far as our present knowledge of the local insect goes, it is impossible to state whether it is a native of this country or an introduction from abroad. A knowledge of its name might be an aid towards the solution of this difficulty, but that at present has not been determined. Its distribution throughout the Colony is not very great, I believe, for I have failed to find it anywhere but in the immediate neighbourhood of Maritzburg. From reports, however, it is also probably found at Greytown, and towards the coast.*



Section of a Mandarin showing Damage done by Natal Codling Moth.

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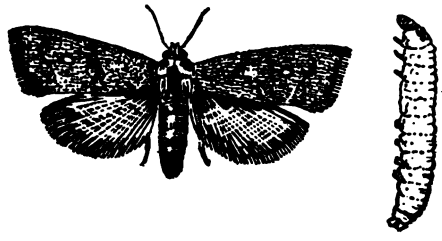
*This insect has since been found at Pinetown and Umzinto.

It attacks a variety of fruits, having been reared by me from plums of various kinds, apricots, peaches, yellow and red guavas, and oranges and mandarins (naatjis). The greatest amount of damage has been noticed in connection with the last three and I have in mind an instance where early last season (1900) a crop of some 40,000 oranges and mandarins was destroyed by the pest, almost before its presence had been noticed. The nature of the damage is not unlike that of the real codling moth, the caterpillar tunnelling the fruit, particularly about the core or stone and leaving in its track its excrement. Oranges last season suffered most severely because a wet rot invariably set in where the fruit had been punctured, or the caterpillar had gained entrance. This spot was, of course, only to be observed by most careful searching, as it was very small. Oranges so affected usually fell from the trees when half decayed. Mandarins (naatjis) did not, as a rule, even in adjoinin gtrees. become attacked by the mould which seized upon the orange; but fruits with the caterpillar inside could always be recognised by a circular black spot, nearly half an inch in diameter. This spot is caused by a fungus growth about the entrance or hole made when the insect penetrated the rind and entered the interior of the fruit. In peaches, apricots and guavas there is very little superficial indication of the caterpillar which is rioting within.

Natural History, Description, etc.

The eggs of the insect have only been observed upon the red or Chinese guavas, and upon these small fruits I have taken from one to a dozen. In this case fully 80 to 90 per cent. were parasitized. The eggs are, I believe, deposited at night. When first laid they are of a translucent white colour and if viewed with a pocket magnifying glass they will be seen to be irridiscent and closely marked all over with minute punctures. They are flat and broadly oval in outline, and measure about one thirty-fifth of an inch in length. When parasitized the eggs appear quite black.

The larva or caterpillar, when full fed and ready to enter the chrysalis stage, measures about $\frac{1}{2}$ inch in length, and $\frac{1}{10}$ of an inch in width. The body is a flesh pink in colour above, and of a pale yellow beneath; the head and shield of the first segment being brown. The legs and pro-legs are concolorous with the abdomen, and there are inconspicuous white hairs upon the body. The fruit is only entered after the caterpillar has hatched from the egg and the entrance is made upon the ripest side. The caterpillar is an active, wriggling creature and can drop to the ground like a spider by spinning a supporting thread during its passage through the air. When full grown it leaves the fruit to pupate, but the condition of the fruit does not hasten its departure. I mean that even if the fruit is in a liquid ferment, or quite dried up, the caterpillar remains feeding upon it until mature. How long it takes to reach this stage I am unable to say, but I have had caterpillars in fruit which had



Moth and Caterpillar of Natal Codling Moth (enlarged 2-3 times natural size).

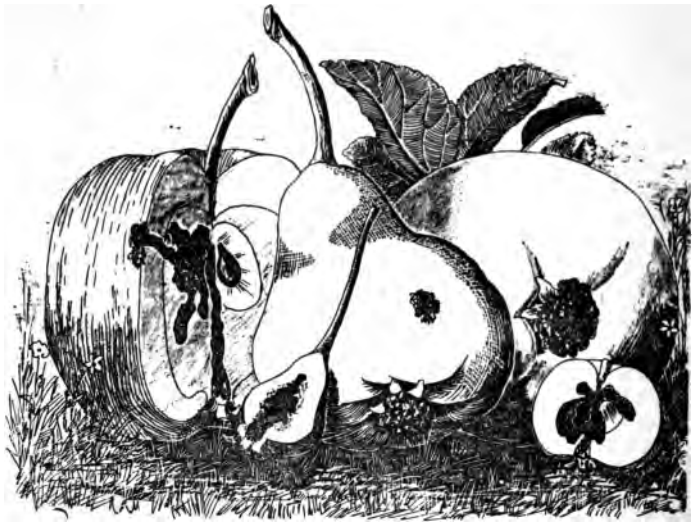
fallen to the ground, for three weeks. The caterpillar, after leaving the fruit, pupates among debris upon the surface of the soil in a small silken cocoon and emerges as a moth during the months of April, May, June, July and August, after a period of two or three weeks. Such is, briefly, the life history, though there remains several important points to be investigated.

Pupa and Cocoon of Natal Codling Moth (enlarged 2-3 times).

The adult moths have a casual likeness in size and tone of colour to the real codling moth, but the coppery patches upon the wings of that species are not present in this. The sexes are well-defined, the male being smaller and possessing curious organs upon the hind wings.

The adult female is of a brown colour. The fore-wings are mottled with shades of brown, violet and grey, having a characteristic upright tuft of red scales near the hind or inner margin and situated at half the length of the wing; at two-thirds the length of the wing, and quite central, is a well defined, small, white spot; beyond this and near the outer margin is a lunulate band of dark brown, and between this and the hind margin is situate an eye-like spot of grey, surrounded by dark brown. The hind-wings are a smoky brown and uniform in colour. Across the wings from tip to tip the insect measures $\frac{3}{4}$ inch.

The adult male is, usually, slightly smaller than the female. The forewings are similarly marked, but more grey in general appearance. The hind wings differ in possessing a pouch-like organ, clothed with silvery scales, opening up the margin, at the anal angle. The hindmost legs of the male are also more plumose than those of the female.



Illustrating damage done to Apples and Pears by the real Codling Moth.

Remedies.

The surest way of mitigating the attack of this pest is to bury the infested fruit in the soil. It should be gathered every day to ensure complete success, and at least three times a week. Preferably a

large hole should be dug and this can be left open for ten or twelve days, but must then be filled in and packed with earth, there being at least eight or ten inches of soil over the oranges.

It is quite possible that upon some fruits the attack of this insect may be met by spraying with Paris green, as for the codling moth, but at present I am not able to make any recommendations in this direction.

THE WATTLE BAG WORM.

Animula sp.

This insect is a pest of more or less importance in nearly every wattle (*Acacia mollissima*) plantation in the Colony and is of common occurrence upon the native mimosas, or "thorn bushes," in many parts. It is known to the Kafir as "hamba-indhlwana," which is to say, the insect that goes about with his little house. It is also popularly spoken of locally as a "caddis-worm," but it does not belong to the same order as this insect. Caddis-worms, it is true, are not altogether unlike moths, but their larvæ are aquatic and have little in common with bag-worms, other than that they inhabit bags of a similar nature.

Habits and Natural History.

This was one of the first insects to which my attention was drawn upon reaching the Colony and in August, 1899, I visited the Hilton Road wattle plantations at the request of its well-known manager, Mr. Pope-Ellis. At the time of my visit I was able to see the extent of the pest in this large plantation of 3,000 acres. Throughout the whole area the worm was to be found, but it was more common and destructive in certain parts than in others—a circumstance difficult to account for, unless these areas were the places where the insect first obtained a foothold in the plantations. During the visit a number of specimens were taken, and from these and subsequent collections, the points touched upon in this discussion of its natural history were established, some being reared in captivity upon wattle trees.

The bag-worm belongs to a family of moths known as the *Psychidæ*, a group of interesting insects having representatives in many parts of the world. Two species, one from North America and the other from Australia, have been reported as destructive tree-defoliators; the former feeding upon a number of fruit, ornamental and forest trees, whilst the latter is destructive to *Pinus insignis*. In the development of the two sexes this family presents a most interesting feature, for, whilst the males emerge from the cocoon as active flying moths, the females degenerate to maggot-like creatures (even the legs of some species disappearing altogether, with the final transformation), and they never leave their bags.

Speaking in general terms, the natural history and habits of our local insect are not unlike those recorded of the American "basket worm," *Thridopteryx ephemeræformis*, Haw. The following is a brief summary of my own observations, which shows a few important differences. The young worms hatch and leave the maternal bag, by the opening at the end, about the second or third week of September. They are small, black creatures, being about one twenty-fourth of an inch in length. Upon emerging from the bag they are particularly active, but with no desire to eat, preferring a life of pleasure and

freedom for several days, which are passed in letting themselves down by silken threads, like spiders, and floating thus suspended in the atmosphere. Should this aerial display of acrobatics bring them in contact with another branch, they will, quite contentedly, strengthen the span thus formed, and use it as a tight rope, up and down which they will travel in an apparently purposeless manner. Often many young worms may be seen upon a network of silk between two branches, the strands being twenty or thirty inches or more in length. It is this curious habit which, to my mind, accounts for the distribution of this insect in a plantation and its spread from the native bushes to new plantations. A circumstance, considering the poor powers of locomotion possessed by the insect, otherwise difficult to understand. The silken threads upon which they hang are sticky and easily broken, and cling to the object which breaks through them. Thus it is easy to conceive some bird or large insect carrying off a score or more minute caterpillars, clinging to broken strands. The feasibility of this I have several times demonstrated by breaking some strands with a stick and carrying the larvæ as far as I felt inclined. When tired of this freedom—which, fortunately, carries the majority to an untimely end—the young worms settle down to construct bags, which, when complete, will resemble that from which they recently emerged. Professor Riley has given a most interesting account of how this is done, by the larva of the American species mentioned above, from which the following may be quoted: "The young larva crawls on a leaf and gnawing little bits from the surface, fastens these together with fine silk, produces a narrow, elongated band which is fastened at both ends to the surface of the leaf by silk threads. Having secured itself from falling down by some threads, it now straddles this band, and, bending its head downwards, makes a dive under it, turns a complete somersault and lies on its back, held down by the band (*Plate XII., fig. 2c.*) By a quick turning movement, the larva regains its feet, the band now extending across its neck (*Fig. 2d.*) It then adds to the band at each end until the two ends meet, and they are fastened together so as to form a narrow collar, which encircles the neck of the worm. Far from resting, it now busies itself by adding row after row to the anterior or lower end of the collar, which thus rapidly grows in girth, and is pushed further and further over the maker (*Fig. 2e*). The inside of this bag is now carefully lined with an additional layer of silk, and the larva then marches off carrying the bag in an upright position. When in motion, or when feeding, the head and the thoracic segments protrude from the lower end of the bag. the rest of the body being bent upward."

The larva of the wattle bag-worm is, I find from observations made by myself, quite as an acrobat in constructing the initial stages of its bag as its American cousin. Indeed it has been watched performing similar feats exactly in the manner, as described in the words of Riley, quoted above. The making of the band upon the leaf surface takes from twenty to thirty minutes, and then, after a minute inspection, the somersault is taken. In four hours from biting out the first piece of leaf the whole insect is encased, but it is not for another two to three hours (six to seven hours in all) that the bag is completed to the entire satisfaction of its owner and ready to be carried about in the upright position shown in figure 2*f*.

Quite a month elapses before the young worms have grown sufficiently to need a bag half an inch in length for their accommodation, and for another month this is scarcely increased in size and is only

covered with shreds and very small pieces of leaf. At the end of two months the bags begin to alter in appearance, much longer pieces of leaf being attached and pieces of twigs and seed-pods as well, making them look very much larger. They are not, however, complete for another month. After the middle of January, whilst the worms feed as much as ever, their bags are not enlarged, and this state of affairs continues until the cold weather sets in about May. They then web the bags tightly to a branch and close the entrance. The male larvæ now pupate and in this stage pass the winter. The female larvæ do not change, but hybernate as caterpillars, and it is not until late in July or early in August that any change occurs. Thus the females only spend from a fortnight to three weeks as pupæ. Shortly after the females pupate, the male moths emerge from their cocoon and visit their maggot-like spouses.

A general idea of the appearance of the bags may be gained from *Figs. 4, 5 and 6, Plate XII.*, and, if at this period they are examined internally, it will be found that, before pupating, the insects have constructed an inner chamber of silk, independent of the outer walls of the bags.

The maggot-like females are seldom found more than halfway out of their horny pupa-shells, and the eggs are deposited in these shells behind them. As the shells are not broken except at the apex, it is difficult to understand how the sexes meet, unless it is possible for connection to be established between the adult male and the pupa female. This, from the construction of the posterior apex of the pupa-shell appears quite feasible.

Description.

The eggs are of a whitish colour, measuring three one-hundredth parts of an inch in diameter; about 1,600 are deposited by each female. The larvæ, when full grown, measure from $\frac{3}{4}$in. to one inch in length. The body is of a dark brown colour, except the head and three throacic segments, the former being mottled with red, and the thoracic segments with three broad, longitudinal bands of a dull, white colour. The chrysalis of the male is of a dark red-brown or almost black colour, about three-fifths of an inch in length, and is of normal appearance.

The adult male is a small brownish moth, with transparent wings. The body, which measures a little over $\frac{1}{2}$in., is clothed with many hair-like scales, giving it a velvety appearance. Across the expanded wings the measurement is about one and one-fifth inches. The abdomen is capable of much extension. The chrysalis of the female is stout, conspicuously segmented, of a reddish-brown colour and about seven-tenths of an inch in length and three-tenths in width. The head of the caterpillar is rudely indicated and the posterior is pointed and furnished with a small orifice.

The adult female is a maggot-like creature. The region of the head and thorax is brown, and of a corneous nature, terminating in two points, all the organs being aborted. The six legs are represented by small, conical papillæ, the largest being those on the first thoracic segment. The eye spots are distinct. The first thoracic segment is furnished with a pair of lateral protruberances, the apices of which are truncate. The abdomenal segments are clothed with a downy hair, and the last ends in a tubular sexual organ, which it is possible the insect passes through the opening in the pupa-shell to cohabit with the male.

Host Plants.

Other than upon acacias and mimosas, these bag-worms are seldom found; they will, however, be occasionally met with upon apple trees and oaks, particularly when growing in the vicinity of wattles.

Natural Enemies, etc.

Comparatively speaking, few bag-worms reach maturity; from my observations of two seasons it appeared that only about 18 per cent. of the full-sized bags found in a plantation contained full-grown insects. The females produced are more numerous than males, but at maturity there is a fairly even number of both sexes. Calculating roughly, from every 100 bags upon the trees only 14,400 eggs are produced, i.e., 1,600 eggs for nine bags only, 9 per cent. of adult females being left. This is small compared with a possible 120,000 should the 75 per cent. of females come to maturity. The destruction of 82 per cent. of the bag-worms during the last stages of their growth (for no notice has been taken of the deaths in the earlier stages), is due to several causes. The larger number succumb to parasitic fungi, others to ichneumon and dipterous flies. Occasionally, too, another enemy, at present unknown, plays a most important role in destroying these insects. What this enemy is I am unable to say, but it secures the bag-worm intact, tearing or cutting a neat circular hole in the side of the bag just large enough to extricate the worm. Without prejudice, I may say that I believe this enemy is a field rat, such as are well known to leave the dry grass and burnt veld in winter, and climb trees to gnaw the bark. Another enemy which has come under my observation is the little silver-eyed bird of the thorns, whom it is most interesting to watch in its careful examination of the bottom entrance of the bags to capture, perchance, an emerging male or waiting female, or even the young caterpillars.

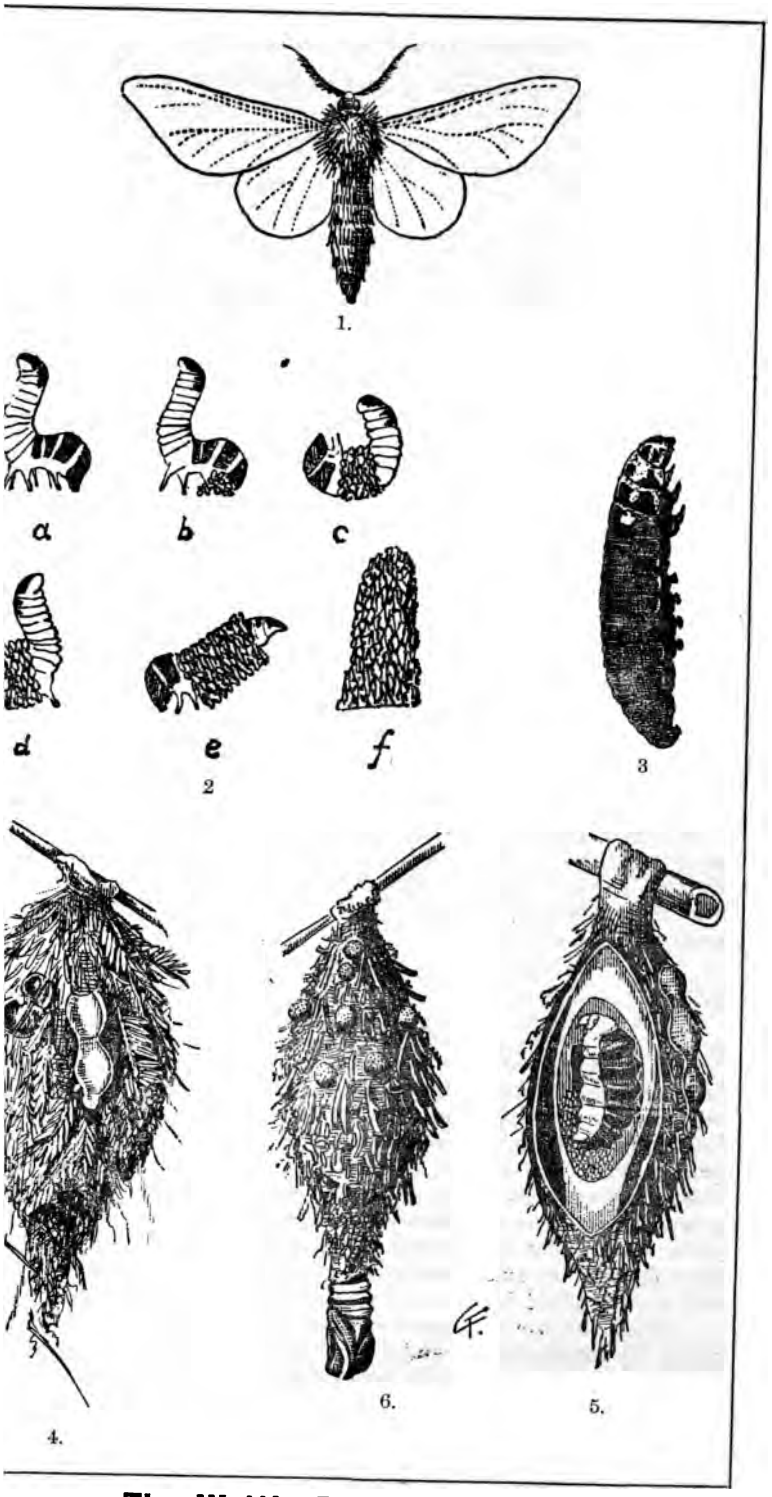
Speaking of newly-hatched worms, I feel certain that a great number never reach the first bag-making stage, falling victims to many untoward circumstances during the time which elapses between emerging from the maternal bag and when they commence to furnish a home for themselves.

Treatment.

In the case of attack upon a few trees, spraying with Paris green and water, or hand picking, should control the pest. Where a large plantation of grown trees is affected, I fear, however, that the profits upon wattle growing are not sufficient to warrant treatment of this sort, if indeed any, unless of course its existence is threatened. This is, considering the number of natural enemies from which the bag-worm suffers, even in seasons favourable to its increase, hardly to be expected. Should the pest appear in large numbers in young plantations, where the trees are well within reach, a profitable plan to adopt would be to hand-pick thoroughly and burn the bags collected, or else spray with Paris green and water.

Explanation of Plate XII.—Fig. 1, the adult male moth; fig. 2, *a*, *b*, *c*, *d*, *e* and *f*, the young larva constructing its bag; fig. 3, the bag worm; fig. 4, full-sized female bag; fig. 5, section of female bag, showing inner chamber and female in pupa shell; fig. 6, full-sized bag of male showing the pupa protruding from the exit just before changing to a moth. (Figs. 1, 3, 4, 5 and 6 original, 4, 5 and 6 loaned by C. P. Lounsbury).

PLATE XII.



The Wattle Bag Worm.

Other Bag-Worms.

There are several other species of bag-worms commonly met w
but concerning the habits and natural history of which very li
has yet been learned. None of them are, however, particularly
structive. One constructs a bag resembling a neat bundle of fagg
some of these have been noticed measuring two and three inche
length, but the majority are much smaller. A second bag-worm fe
on grass in its earlier stages and later on shrubs, including the gra
vine, plum and apricot. This forms a bag of a somewhat sexago
form, cutting grass haulms into short lengths and placing th
crosswise. In its later stages the worm covers the outside of the b
with a strong coat of grey silk. Around this insect, and other b
worms, has gathered a Kafir idea—believed in by many—to the eff
that cattle eating them, die foaming at the mouth. Personally,
believe that this story is little more than a myth.

FRUIT PIERCING MOTHS.

There exist in Natal quite a number of moths which are credit
with piercing and destroying a large variety of fruits, and these,
a rule, are more plentiful upon the coast than inland. There are th
species which are very common and often found, particularly at nig
imbibing the juices of fruits, which they appear to have pierced wi
their long tongues. The best known of all these is the handso
insect so commonly spoken of as the Peach Moth (*Egybolia vaillanti*
which is chiefly confined to the coast belt. The second species is f
more prevalent and common, as it abounds in swarms on the co
and has been taken in the Maritzburg-Greytown belt also. Th
insect is, however, not so well known, chiefly on account of its d
colouring, but it is far more destructive to fruit than any other kin
It is called the Fruit Moth (*Ophiuza leinardi*), and is credited wi
much mischief in Cape Colony. The third species (*Spingomorp
chlorea*) is very common upon the coast and I have taken it as fa
up-country as Ladysmith, but, so far as my observations go, it onl
feeds upon fallen fruit.

The Peach Moth.

Egybolia vaillantina, Stoll.

This moth I have taken upon a number of occasions and at all
hours of the day and night, feeding upon mangoes. When resting upon
the fruit, it has a distinct triangular form, due to the way the wings
are held. It then measures 1½ inches across the base of the triangle
(which is formed by the outer margins of the two fore-wings), and
one inch from the centre of this to the head. Owing to its brilliant
colouring, it is a very conspicuous object whilst feeding, and so is
often seen. This has gained it the reputation of being a worse pest
than it really is and of doing an amount of damage which, with more
propriety, should be credited to the insect we term Fruit Moth.

With the wings expanded, as in flight, the Peach Moth measures
about 2¼ inches across, and from head to the tip of the abdomen is
about one inch. The moth may be described as a dark, metallic-blue
insect, with bright, orange-yellow markings. The body and thorax
are of a uniform metallic blue, the head, palpi, and antennæ being
orange. The eyes are black. The legs are concolorous with the body,
except that the tibia of the front pair are orange-yellow, and also

t the extremity of this joint. in the two hindmost pairs of legs, is ged with the same colour. The fore-wings differ from the hind- gs in two respects. In the former the ground colour has a green ge in it, and the wings are crossed near the base with a broad band range-yellow, bordered with a narrow band of black. Beyond this in there is a black band traversing the wing from the inner margin ost to the outer. On the inner margin, where this band originates, re is a small, yellow spot and, where it finishes before reaching outer margin, it borders on the outer side an irregular, oblong, nge-coloured patch, between which and the margin is a further aller patch of orange. The hind-wings are bluer in colour, the er area being darker than the marginal, and without yellow rkings. (*See Plate XIII., fig. 1*).

The life history of this insect I have not been able to study, my friend, J. F. Queckett, Curator of the Durban Museum, has plied me with caterpillars taken upon *Sapindus oblongifolius* nders, and also specimens of the empty chrysalides and the oons.

These caterpillars measure $1\frac{1}{2}$ to $1\frac{3}{4}$ inches in length, and are of a k-brown colour, marked with rings of creamy yellow. These ear to be variable, as in one of the specimens each segment is rked with but one band, whilst in the other there is a succession narrow bands of brown and yellow from head to tail, there being or three of each to either segment. The body is further marked h six rows of small conical tubercles or warts, there being ten these to most segments. There are but three pairs of prolegs; se on the third abdominal segment being obliterated. (*See Plate II., figs. 3 and 4*).

The pupæ are, apparently, similarly coloured to the larvæ, the dominal portion being marked with a succession of rings of brown l yellow and the wing sheaths striated with the same colours. (*See te XIII., fig. 2*).

The cocoons are formed by joining together one or two leaves h an open network of white and yellowish silk, through the meshes which the pupæ are easily seen.

The Fruit Moth.

Ophiuza leinardi.

Syn: *Achroae chamelion.*

The title "Fruit Moth" has already been employed in describing s species in Cape Colony and for uniformity I have adopted it e. It is by far the most common and destructive species, though has not the bad reputation of the Peach Moth, a circumstance no bt due to the fact that it is but seldom seen upon the fruit in the ytime, except, perhaps, an occasional belated individual in the ly morning. During the day the Fruit Moth, as a rule, lies due in the grass or in some dense foliage or herbage the neighbourhood of the fruiting trees. In one case that came der my notice three cypress trees were growing in close proximity to grove of mangoes and in these the moths swarmed like bees. alking through the bush in January and February in the neigh- urhood of the sea, the moths "start" in front of one all along the y. These find sustenance from the many ripening fruits with which e bush is now full, that of one tree, known to the Kafirs as "um- amtu," and technically as *Ekerbergia Meyeri*, being particularly

favoured. Fruit Moths are exceedingly timid creatures, whose tory organs must be very sensitive, as upon anyone approaching hiding places, they leave precipitately with rapid and erratic fli erratic in appearance—but carrying them safely from one dark l place to another. At night, however, they are not so shy and disturbed fly with more steady progress as compared with the wil made in daylight.

Like the Peach Moths, these have a flat, triangular appe when feeding upon the fruit. With wings outstretched they m from 2¼ to 2½ inches, and from an inch to a little over in the of the body from the head to the tip of the tail. Viewed from in the colouration of the fore-wings, the moths are very varial *Plate XIII., figs. 5 and 6.*) The markings may be generalised as and grey to greyish purple in colour; but in some cases they are m uniform yellowish or purple brown. In all, however, two tra bands are always to be traced, which divide the wing into areas. The first is almost straight and crosses the wing at on the distance from base to apex. The second is always zig-za crosses at two-thirds the distance from base to apex. The m of the moths have the area between the base and the first bar dark brown. The intermediate area may be greyish, grey-br purple, whilst the outer area is a variegation of both. Apar those which have the fore-wings uniform throughout, are some are uniform except for a triangular, dark brown spot, upon th margin near the apex of the wing.

The hind wings are more uniformly marked, being smoky brown, relieved with four white spots, one central anc upon the margin.

Viewed from beneath, the markings are always unifor characterised by a broad white band which traverses the for (*See Plate XIII., fig. 7*).

Where the hosts of the Fruit Moth have their origin i present impossible to say. Mr. J. F. Queckett remembers rear moth at one time and believes that the early stages will s re-observed. Recently I reared a rare variety of *O. leinardi* moth being, in this case, exactly like the typical insects in constant markings, but differing from all in the colouration fore-wings, which are an iron-grey. The larva was taken upon the flowers of the well-known "Pride of India" (*Lage indica*) at Ladysmith and was of a dark uniform brown cc to 2½ inches in length and belonging to that group of cate known as semi-loopers. In pupating, it spun a fairly strong of white silk, webbing together odd leaves. The pupa wa in colour, and covered with a grey "bloom."

THE NIGHT OR DINNER MOTH.

Sphingomorpha chlorea, Cran.

Syn:—*S. monteironis*, Butl.

This is a more powerful insect than either of the two pr mentioned and, in general appearance and flight, much re the Sphinx or Hawk moths so commonly seen in the twilight i the juices from garden flowers. In its habits it is essentially n and I have never noticed it in daylight except in hiding. It i the Dinner Moth by those who take their dinner late in t because it is no uncommon occurrence for it to come to the tab

the lamps are lighted. Writing to me some little while ago concerning it, Mr. J. M. Handley, of Greytown, said: "One evening one came into the dining room and settled upon a fig. He used his proboscis just like a pick until he found out the hole at the end of the fig." At night I have found the moths in large numbers around fruit trees in company with the Fruit Moth. Very seldom have I, however, seen them upon hanging fruit, they preferring such as has fallen to the ground, particularly those beginning to ferment. This moth may at once be distinguished from the Fruit Moth by its larger size, the wings measuring $2\frac{3}{4}$ inches in expanse. The body is also more robust, and, from head to tail, measures 1 to $1\frac{1}{3}$ inches. One of the most characteristic features of the female insect is to be found upon examining the front pair of legs. Usually these are not seen at once, as they are clasped under the body, but if withdrawn they will be seen to be ornamented with a fan-like beard, formed of a most liberal supply of hair-like scales. The tibia also are much swollen and apparently the seat of some highly organised organ. The fore-wings of the insect are mottled with varying shades of brown upon the upper surface, and somewhat transversed with irregular narrow bands. The hind-wings are more uniform in the arrangement of colours, the marginal area being of a smoky brown edged with yellowish brown. The body is of a dark or almost black brown and marked with a distinct band of greyish colour, which passes down the centre from between the eyes to the last segment, which itself is concolourous with this band. Upon the undersides, both wings and body are of a light yellowish brown, uniform except for dark, central blotches on each of the four wings. (*See Plate XIII., fig. 8*).

REMARKS.

Throughout the above notes I have referred to the Peach Moth and the Fruit Moth as destroyers of fruit and, whilst this is strictly correct, still there exists a doubt, which I have not been able to clear up, as to whether the moths are able to pierce the rind of the fruit. Speaking of the attack upon Japanese plums and mangoes—for most of my observations are in connection with these fruits—I can say emphatically of the Fruit Moth that it will feed on these in all stages of ripeness, i.e., from that stage when the fruit begins to turn from greenness to ripeness until they ferment and decay. Firm mangoes provide the best opportunity of seeing how the moths destroy the tissue and if one is examined the method of the moth's feeding is nicely exemplified. Thus, by cutting down through a puncture and sectioning the fruit, a direct channel will be seen to pierce the tissues for an eighth of an inch or more, and then from this will radiate outwards and downwards through the pulp a regular labyrinth of channeling. A single mango may be punctured in a dozen places and at night, as long as it hangs, as many moths will attend at these orifices pumping the mango dry, and when it falls and bursts, its juices will be lapped in the daytime by an occasional butterfly or perhaps an odd Peach Moth, whilst at night Fruit Moths and numbers of Night Moths as well will come to it.

The puncture, through which the tongue of the moth is thrust, is about one-fiftieth of an inch in diameter. How this puncture is made, whether by the moth or some other insect, is an open question. Their are many farmers and gardeners who stoutly maintain that the moths pierce the fruit with the tongue or proboscis. Most of them even go further and aver that fruit-maggot infestation is but a consequence of the attack of the moth, as the flies only use the holes

PLATE XIII.

1.

3.

2.

4.

5.

6.

7.

8.

Claude Fuller, del.

Three Fruit Moths.

made by the moths to lay their eggs in. Others again are equally certain that the moths simply follow in the track of some or any puncturing insect and believe that were the fruit not punctured thus, there would be no moth attack.

The good folk who hold that the fruit fly follows the moth are wrong in their contention, for the fruit fly can and does puncture fruit quite readily, with a specially adapted organ, for the purpose of laying its eggs beneath the rind of the fruit. Their mistake is probably due to observing maggots of the ferment-fly in fruit destroyed by the moths, but these larvæ are quite different to those of the fruit fly and are only found in broken or over-ripe fruit. Whilst those who hold the opposite opinion have, so far, the weight of evidence upon their side.

As already intimated, I am not able to say whether the moths —particularly by the Fruit Moth—can or cannot puncture fruit. This I am, however, able to say, that if they cannot then the fruit fly is about the only agent I have come across that they can get to do the work for them. For four consecutive days I had a severe case of moth-attack closely under observation, and during that time a consistent search was made for an insect which could, with certainty, make holes similar to those employed by the moths. The only insect seen was the fruit fly. These were common enough, but in 100 examinations of punctures neither eggs or maggots of this insect could be found, nor did a more thorough search reveal anything. Indeed it looked to me as if the fly had punctured the fruit in depositing its eggs, but, the puncture being at once taken possession of by a moth, the eggs were destroyed by its proboscis.

At the same time that these observations were made, other experiments were tried which indicated that the moths do not pierce the fruit. Several moths were imprisoned in a cage with a sound Japanese plum. After three days it was not pierced, and only one moth remained alive. The skin of the fruit was then broken, and the remaining moth lived for four more days. In another instance *O. lenardi* and *S. chlorea* were imprisoned with a sound mango. They kept alive for 50 to 60 hours without piercing the fruit and then died. Further, a mango which had been pierced already in six places, but still sound and ripe, was selected, the punctures closed with wax and the fruit well smeared with mango juice to disguise any taint from handling. This was used as a decoy. A great quantity of the mangoes from four adjoining trees were gathered into a heap near by. This was covered with brown paper, so that the moths could not get to them, and the decoy mango set outside upon the top of the heap. It remained in this position over two nights and, though moths were seen to settle upon it, it was not again pierced. It is thus seen that the evidence which I have been able to collect favours the opinion of those who hold that the moth uses the holes made by other piercing insects, yet I am so struck by the quantities of fruit destroyed that I am quite open to conviction, upon satisfactory evidence, that several species of moths can puncture fruit.

In addition to the three moths mentioned above, I may mention that I have had several species of *Ophideres* sent to me as fruit piercers, and that the genus *Ophiuza* has four other representatives in the Colony, which have been shown me by Mr. J. F. Queckett. These are *O. echo*, *O. propans*, *O. illustrata*, and a species which feeds upon a wild liburnum in its caterpillar stage.

F

Treatment.

Too little is as yet known of these pests to recommend any course of treatment, except the use of netting similar to that for keeping off the attack of the fruit fly. Eventually some way may be discovered of circumventing the pests, but this will only follow upon a knowledge of their natural histories. Hanging poisoned baits in the fruit trees will, I believe, from my own experience, prove successful and Mr. J. Harcourt, Richmond, attributes the immunity of his fruit from moth-attack to systematic trapping. For this purpose he originally employed lamps standing in wide milk pans, in which there was water with paraffin floating on the surface. He now, however, prefers to use wide-mouthed jars, suspending them in the trees, and keeping them half full of a mixture of vinegar, sugar and water.

Explanation of Plate XIII.—Fig. 1, the Peach Moth (*Egybolia vaillantina*); fig. 2, pupa of the Peach Moth, figs. 3 and 4, larvæ of the Peach Moth. Fig. 5, the Fruit Moth (*Ophiuza leinardi*); fig. 6, upper wing of same species showing variation of markings; fig. 7, view of undersurfaces of wings of Fruit Moth. Fig. 8, the Night Moth (*Sphingomorpha chlorea*).

CUTWORMS.

Cutworms are the caterpillars of certain night-flying moths, somewhat allied to the moth of the mealie grub, which do considerable damage in tobacco plantations and vegetable gardens. They live a great deal in the soil and generally remain there throughout the day, doing their feeding at night only, travelling from plant to plant, and cutting it off on a level with the earth. The damage they do in this manner sometimes amounts to a very great deal indeed, and fields of tobacco have at times to be entirely replanted or just left to them. When full grown the worms pupate in little earthen cells, made in the soil, and subsequently emerge as moths. (*See Plate XIV., figs. 1 and 2*).

In turning up a grass plot one very often comes across a number of these insects, and it is generally safe to say that, in the case of a severe attack upon young tobacco, cabbage or turnip crops, the worms were already in the lands when the plants were set out. This, indeed, is generally recognised as being the case and it is usual to bait the lands for the cutworms a day or two before planting out. A very useful bait for this purpose may be prepared with a pound of arsenic and 50 pounds of bran—these are mixed and made into a mash by adding water; it is then sweetened with molasses and fairly large spoonsfuls are placed at regular intervals over the land. This bait can also be used where the worms are already at work, or trap baits may be laid of cabbage leaves or lucerne. These should be poisoned by dipping in a mixture of Paris green and water, using the poison at the strength of 1lb. to 50 gallons of water.

In cases of attack in small gardens it will often be found to pay to put an umfaan on collecting the worms, as these can usually be found with ease in the soil about the bases of the plants which have been destroyed over night. Another suggestion, which is not so unpractical as it looks, is to place collars round the individual plants. These are best made of tin, and the sides of jam tins, after the tops and bottoms have been melted out, act very well, as they can be sprung around the plant and pushed into the soil for an inch or so.

An American suggestion is to use old newspapers cut into sheets 9 by 12 inches. These are painted with cheap, quick-drying black paint or waterproof varnish. Cut the sheets from edge to centre

and, the plant being set, slip a piece of paper round it and keep it down flat with two or three stones or clods. The grub, it is claimed, will not crawl on to these papers, which, with care, will last several years, as they can be taken away after a week or ten days.

THE CABBAGE MOTH.

Plutella cruciferarum, Zell.

The Cabbage Moth is an introductin from Europe and from thence it has migrated, in one way or another, to every clime where cabbages and other cruciferous vegetables are cultivated. In some of these countries it is more destructive than in others, and I believe I may say with safety that, for the present, at any rate, it is not of great importance as a pest in this. The eggs are laid upon the plants by the moth, and from these small, green caterpillars in a short time make their appearance, and feed upon the leaves, often leaving little of them but the stem, ribs and veins. Having fed to repletion, the caterpillar, now a bright-green colour, spin a lace-like cocoon and pupate within it; emerging therefrom as small greyish-brown moths. This pest is generally referred to in England as the Diamond Back Moth, a name which originates from the diamond-shaped arrangement formed by the lighter-coloured areas of the fore-wings when brought together in a state of rest. (*See Plate XIV., fig. 3*).

Remedies.

Spraying with Paris green when feasible, or with a solution of coal-tar water (1lb. of coal tar to 100 gallons of water) which must be applied several times during growth to be effective. Good cultivation and use of manures, to force a rapid growth, mitigate the mischief of the pest to a very great extent.

THE GRAIN MOTH.

Gelechia cerealla, Oliv.

In addition to the attack of weevils, not a little damage is often done to stored mealies by the Grain Moth. This pest has long been known in Southern Europe and has now spread to most parts of the world. Its attack upon grain is not unlike that of the weevil. Indeed, many think that it is the moth that lays the eggs which produce the weevil, but this is a fallacy, as the eggs of moths can produce but moths, and from weevils' eggs only weevils can come.

The eggs of this insect are often deposited on the cobs whilst still in the field, and the small caterpillars which hatch out from them burrow their way into the grains. When it is full grown the caterpillar spins a cocoon in the grain and emerges therefrom as a small, greyish-brown moth, which in a very short time lays another brood of eggs to carry on the destructive work. (*See Plate XIV., fig .4*)

Remedies.

A very practical recommendation for the treatment of this pest has been given by an American entomologist, Mr. F. H. Chittenden. He recommends storing the grain in bulk and keeping it well stirred by shovelling or agitating it by other means. This is claimed to be productive of the best results, as the moth is so soft and delicate and easily crushed, that it is unable, when buried beneath a large mass of

Other Bag-Worms.

There are several other species of bag-worms commonly met with but concerning the habits and natural history of which very little has yet been learned. None of them are, however, particularly destructive. One constructs a bag resembling a neat bundle of faggots; some of these have been noticed measuring two and three inches in length, but the majority are much smaller. A second bag-worm feeds on grass in its earlier stages and later on shrubs, including the grape-vine, plum and apricot. This forms a bag of a somewhat sexagonal form, cutting grass haulms into short lengths and placing them crosswise. In its later stages the worm covers the outside of the bag with a strong coat of grey silk. Around this insect, and other bag-worms, has gathered a Kafir idea—believed in by many—to the effect that cattle eating them, die foaming at the mouth. Personally, I believe that this story is little more than a myth.

FRUIT PIERCING MOTHS.

There exist in Natal quite a number of moths which are credited with piercing and destroying a large variety of fruits, and these, as a rule, are more plentiful upon the coast than inland. There are three species which are very common and often found, particularly at night, imbibing the juices of fruits, which they appear to have pierced with their long tongues. The best known of all these is the handsome insect so commonly spoken of as the Peach Moth (*Egybolia vaillantina*) which is chiefly confined to the coast belt. The second species is far more prevalent and common, as it abounds in swarms on the coast, and has been taken in the Maritzburg-Greytown belt also. This insect is, however, not so well known, chiefly on account of its dull colouring, but it is far more destructive to fruit than any other kind. It is called the Fruit Moth (*Ophiuza leinardi*), and is credited with much mischief in Cape Colony. The third species (*Spingomorpha chlorea*) is very common upon the coast and I have taken it as far up-country as Ladysmith, but, so far as my observations go, it only feeds upon fallen fruit.

The Peach Moth.

Egybolia vaillantina, Stoll.

This moth I have taken upon a number of occasions and at all hours of the day and night, feeding upon mangoes. When resting upon the fruit, it has a distinct triangular form, due to the way the wings are held. It then measures 1½ inches across the base of the triangle (which is formed by the outer margins of the two fore-wings), and one inch from the centre of this to the head. Owing to its brilliant colouring, it is a very conspicuous object whilst feeding, and so is often seen. This has gained it the reputation of being a worse pest than it really is and of doing an amount of damage which, with more propriety, should be credited to the insect we term Fruit Moth.

With the wings expanded, as in flight, the Peach Moth measures about 2¼ inches across, and from head to the tip of the abdomen is about one inch. The moth may be described as a dark, metallic-blue insect, with bright, orange-yellow markings. The body and thorax are of a uniform metallic blue, the head, palpi, and antennæ being orange. The eyes are black. The legs are concolorous with the body, except that the tibia of the front pair are orange-yellow, and also

that the extremity of this joint. in the two hindmost pairs of legs, is inged with the same colour. The fore-wings differ from the hind-ings in two respects. In the former the ground colour has a green nge in it, and the wings are crossed near the base with a broad band f orange-yellow, bordered with a narrow band of black. Beyond this gain there is a black band traversing the wing from the inner margin most to the outer. On the inner margin, where this band originates, here is a small, yellow spot and, where it finishes before reaching the outer margin, it borders on the outer side an irregular, oblong, orange-coloured patch, between which and the margin is a further smaller patch of orange. The hind-wings are bluer in colour, the inner area being darker than the marginal, and without yellow markings. (*See Plate XIII., fig. 1*).

The life history of this insect I have not been able to study, but my friend, J. F. Queckett, Curator of the Durban Museum, has supplied me with caterpillars taken upon *Sapindus oblongifolius* Saunders, and also specimens of the empty chrysalides and the cocoons.

These caterpillars measure 1½ to 1¾ inches in length, and are of a dark-brown colour, marked with rings of creamy yellow. These appear to be variable, as in one of the specimens each segment is marked with but one band, whilst in the other there is a succession of narrow bands of brown and yellow from head to tail, there being two or three of each to either segment. The body is further marked with six rows of small conical tubercles or warts, there being ten of these to most segments. There are but three pairs of prolegs; those on the third abdominal segment being obliterated. (*See Plate XIII., figs. 3 and 4*).

The pupæ are, apparently, similarly coloured to the larvæ, the abdominal portion being marked with a succession of rings of brown and yellow and the wing sheaths striated with the same colours. (*See Plate XIII., fig. 2*).

The cocoons are formed by joining together one or two leaves with an open network of white and yellowish silk, through the meshes of which the pupæ are easily seen.

The Fruit Moth.

Ophiuza leinardi.

Syn: *Achroae chamelion.*

The title "Fruit Moth" has already been employed in describing this species in Cape Colony and for uniformity I have adopted it here. It is by far the most common and destructive species, though it has not the bad reputation of the Peach Moth, a circumstance no doubt due to the fact that it is but seldom seen upon the fruit in the daytime, except, perhaps, an occasional belated individual in the early morning. During the day the Fruit Moth, as a rule, lies perdue in the grass or in some dense foliage or herbage in the neighbourhood of the fruiting trees. In one case that came under my notice three cypress trees were growing in close proximity to a grove of mangoes and in these the moths swarmed like bees. Walking through the bush in January and February in the neighbourhood of the sea, the moths "start" in front of one all along the way. These find sustenance from the many ripening fruits with which the bush is now full, that of one tree, known to the Kafirs as "umnvamtu," and technically as *Ekerbergia Meyeri*, being particularly

favoured. Fruit Moths are exceedingly timid creatures, whose auditory organs must be very sensitive, as upon anyone approaching their hiding places, they leave precipitately with rapid and erratic flight—erratic in appearance—but carrying them safely from one dark hiding place to another. At night, however, they are not so shy and when disturbed fly with more steady progress as compared with the wild dash made in daylight.

Like the Peach Moths, these have a flat, triangular appearance when feeding upon the fruit. With wings outstretched they measure from 2¼ to 2½ inches, and from an inch to a little over in the length of the body from the head to the tip of the tail. Viewed from above, in the colouration of the fore-wings, the moths are very variable (*see Plate XIII., figs. 5 and 6.*) The markings may be generalised as brown and grey to greyish purple in colour; but in some cases they are more of a uniform yellowish or purple brown. In all, however, two transverse bands are always to be traced, which divide the wing into three areas. The first is almost straight and crosses the wing at one-third the distance from base to apex. The second is always zig-zag and crosses at two-thirds the distance from base to apex. The majority of the moths have the area between the base and the first band of a dark brown. The intermediate area may be greyish, grey-brown or purple, whilst the outer area is a variegation of both. Apart from those which have the fore-wings uniform throughout, are some which are uniform except for a triangular, dark brown spot, upon the fore-margin near the apex of the wing.

The hind wings are more uniformly marked, being of a smoky brown, relieved with four white spots, one central and three upon the margin.

Viewed from beneath, the markings are always uniform and characterised by a broad white band which traverses the fore-wing. (*See Plate XIII., fig. 7*).

Where the hosts of the Fruit Moth have their origin it is at present impossible to say. Mr. J. F. Queckett remembers rearing the moth at one time and believes that the early stages will soon be re-observed. Recently I reared a rare variety of *O. leinardi.* The moth being, in this case, exactly like the typical insects in all the constant markings, but differing from all in the colouration of the fore-wings, which are an iron-grey. The larva was taken feeding upon the flowers of the well-known "Pride of India" (*Lagerstræma indica*) at Ladysmith and was of a dark uniform brown colour, 2 to 2½ inches in length and belonging to that group of caterpillars known as semi-loopers. In pupating, it spun a fairly strong cocoon of white silk, webbing together odd leaves. The pupa was brown in colour, and covered with a grey "bloom."

THE NIGHT OR DINNER MOTH.

Sphingomorpha chlorea, Cran.

Syn:—*S. monteironis*, Butl.

This is a more powerful insect than either of the two previously mentioned and, in general appearance and flight, much resembles the Sphinx or Hawk moths so commonly seen in the twilight imbibing the juices from garden flowers. In its habits it is essentially nocturnal and I have never noticed it in daylight except in hiding. It is called the Dinner Moth by those who take their dinner late in the day, because it is no uncommon occurrence for it to come to the table when

the lamps are lighted. Writing to me some little while ago concerning it, Mr. J. M. Handley, of Greytown, said: "One evening one came into the dining room and settled upon a fig. He used his proboscis just like a pick until he found out the hole at the end of the fig." At night I have found the moths in large numbers around fruit trees in company with the Fruit Moth. Very seldom have I, however, seen them upon hanging fruit, they preferring such as has fallen to the ground, particularly those beginning to ferment. This moth may at once be distinguished from the Fruit Moth by its larger size, the wings measuring $2\frac{3}{4}$ inches in expanse. The body is also more robust, and, from head to tail, measures 1 to $1\frac{1}{3}$ inches. One of the most characteristic features of the female insect is to be found upon examining the front pair of legs. Usually these are not seen at once, as they are clasped under the body, but if withdrawn they will be seen to be ornamented with a fan-like beard, formed of a most liberal supply of hair-like scales. The tibia also are much swollen and apparently the seat of some highly organised organ. The fore-wings of the insect are mottled with varying shades of brown upon the upper surface, and somewhat transversed with irregular narrow bands. The hind-wings are more uniform in the arrangement of colours, the marginal area being of a smoky brown edged with yellowish brown. The body is of a dark or almost black brown and marked with a distinct band of greyish colour, which passes down the centre from between the eyes to the last segment, which itself is concolourous with this band. Upon the undersides, both wings and body are of a light yellowish brown, uniform except for dark, central blotches on each of the four wings. (*See Plate XIII., fig. 8*).

REMARKS.

Throughout the above notes I have referred to the Peach Moth and the Fruit Moth as destroyers of fruit and, whilst this is strictly correct, still there exists a doubt, which I have not been able to clear up, as to whether the moths are able to pierce the rind of the fruit. Speaking of the attack upon Japanese plums and mangoes—for most of my observations are in connection with these fruits—I can say emphatically of the Fruit Moth that it will feed on these in all stages of ripeness, i.e., from that stage when the fruit begins to turn from greenness to ripeness until they ferment and decay. Firm mangoes provide the best opportunity of seeing how the moths destroy the tissue and if one is examined the method of the moth's feeding is nicely exemplified. Thus, by cutting down through a puncture and sectioning the fruit, a direct channel will be seen to pierce the tissues for an eighth of an inch or more, and then from this will radiate outwards and downwards through the pulp a regular labyrinth of channeling. A single mango may be punctured in a dozen places and at night, as long as it hangs, as many moths will attend at these orifices pumping the mango dry, and when it falls and bursts, its juices will be lapped in the daytime by an occasional butterfly or perhaps an odd Peach Moth, whilst at night Fruit Moths and numbers of Night Moths as well will come to it.

The puncture, through which the tongue of the moth is thrust, is about one-fiftieth of an inch in diameter. How this puncture is made, whether by the moth or some other insect, is an open question. Their are many farmers and gardeners who stoutly maintain that the moths pierce the fruit with the tongue or proboscis. Most of them even go further and aver that fruit-maggot infestation is but a consequence of the attack of the moth, as the flies only use the holes

PLATE XIII.

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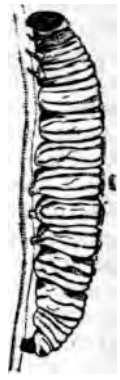

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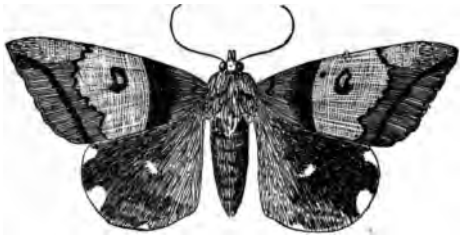


5.

6.

7.

8.

Claude Fuller, del.

Three Fruit Moths.

made by the moths to lay their eggs in. Others again are equally certain that the moths simply follow in the track of some or any puncturing insect and believe that were the fruit not punctured thus, there would be no moth attack.

The good folk who hold that the fruit fly follows the moth are wrong in their contention, for the fruit fly can and does puncture fruit quite readily, with a specially adapted organ, for the purpose of laying its eggs beneath the rind of the fruit. Their mistake is probably due to observing maggots of the ferment-fly in fruit destroyed by the moths, but these larvæ are quite different to those of the fruit fly and are only found in broken or over-ripe fruit. Whilst those who hold the opposite opinion have, so far, the weight of evidence upon their side.

As already intimated, I am not able to say whether the moths —particularly by the Fruit Moth—can or cannot puncture fruit. This I am, however, able to say, that if they cannot then the fruit fly is about the only agent I have come across that they can get to do the work for them. For four consecutive days I had a severe case of moth-attack closely under observation, and during that time a consistent search was made for an insect which could, with certainty, make holes similar to those employed by the moths. The only insect seen was the fruit fly. These were common enough, but in 100 examinations of punctures neither eggs or maggots of this insect could be found, nor did a more thorough search reveal anything. Indeed it looked to me as if the fly had punctured the fruit in depositing its eggs, but, the puncture being at once taken possession of by a moth, the eggs were destroyed by its proboscis.

At the same time that these observations were made, other experiments were tried which indicated that the moths do not pierce the fruit. Several moths were imprisoned in a cage with a sound Japanese plum. After three days it was not pierced, and only one moth remained alive. The skin of the fruit was then broken, and the remaining moth lived for four more days. In another instance *O. lenardi* and *S. chlorea* were imprisoned with a sound mango. They kept alive for 50 to 60 hours without piercing the fruit and then died. Further, a mango which had been pierced already in six places, but still sound and ripe, was selected, the punctures closed with wax and the fruit well smeared with mango juice to disguise any taint from handling. This was used as a decoy. A great quantity of the mangoes from four adjoining trees were gathered into a heap near by. This was covered with brown paper, so that the moths could not get to them, and the decoy mango set outside upon the top of the heap. It remained in this position over two nights and, though moths were seen to settle upon it, it was not again pierced. It is thus seen that the evidence which I have been able to collect favours the opinion of those who hold that the moth uses the holes made by other piercing insects, yet I am so struck by the quantities of fruit destroyed that I am quite open to conviction, upon satisfactory evidence, that several species of moths can puncture fruit.

In addition to the three moths mentioned above, I may mention that I have had several species of *Ophideres* sent to me as fruit piercers, and that the genus *Ophiuza* has four other representatives in the Colony, which have been shown me by Mr. J. F. Queckett. These are *O. echo*, *O. propans*, *O. illustrata*, and a species which feeds upon a wild liburnum in its caterpillar stage.

Treatment.

Too little is as yet known of these pests to recommend any course of treatment, except the use of netting similar to that for keeping off the attack of the fruit fly. Eventually some way may be discovered of circumventing the pests, but this will only follow upon a knowledge of their natural histories. Hanging poisoned baits in the fruit trees will, I believe, from my own experience, prove successful and Mr. J. Harcourt, Richmond, attributes the immunity of his fruit from moth-attack to systematic trapping. For this purpose he originally employed lamps standing in wide milk pans, in which there was water with paraffin floating on the surface. He now, however, prefers to use wide-mouthed jars, suspending them in the trees, and keeping them half full of a mixture of vinegar, sugar and water.

Explanation of Plate XIII.—Fig. 1, the Peach Moth (*Egybolia vaillantina*); fig. 2, pupa of the Peach Moth, figs. 3 and 4, larvæ of the Peach Moth. Fig. 5, the Fruit Moth (*Ophiuza leinardi*); fig. 6, upper wing of same species showing variation of markings; fig. 7, view of undersurfaces of wings of Fruit Moth. Fig. 8, the Night Moth (*Sphingomorpha chlorea*).

CUTWORMS.

Cutworms are the caterpillars of certain night-flying moths, somewhat allied to the moth of the mealie grub, which do considerable damage in tobacco plantations and vegetable gardens. They live a great deal in the soil and generally remain there throughout the day, doing their feeding at night only, travelling from plant to plant, and cutting it off on a level with the earth. The damage they do in this manner sometimes amounts to a very great deal indeed, and fields of tobacco have at times to be entirely replanted or just left to them. When full grown the worms pupate in little earthen cells, made in the soil, and subsequently emerge as moths. (*See Plate XIV., figs. 1 and 2*).

In turning up a grass plot one very often comes across a number of these insects, and it is generally safe to say that, in the case of a severe attack upon young tobacco, cabbage or turnip crops, the worms were already in the lands when the plants were set out. This, indeed, is generally recognised as being the case and it is usual to bait the lands for the cutworms a day or two before planting out. A very useful bait for this purpose may be prepared with a pound of arsenic and 50 pounds of bran—these are mixed and made into a mash by adding water; it is then sweetened with molasses and fairly large spoonsfuls are placed at regular intervals over the land. This bait can also be used where the worms are already at work, or trap baits may be laid of cabbage leaves or lucerne. These should be poisoned by dipping in a mixture of Paris green and water, using the poison at the strength of 1lb. to 50 gallons of water.

In cases of attack in small gardens it will often be found to pay to put an umfaan on collecting the worms, as these can usually be found with ease in the soil about the bases of the plants which have been destroyed over night. Another suggestion, which is not so unpractical as it looks, is to place collars round the individual plants. These are best made of tin, and the sides of jam tins, after the tops and bottoms have been melted out, act very well, as they can be sprung around the plant and pushed into the soil for an inch or so.

An American suggestion is to use old newspapers cut into sheets 9 by 12 inches. These are painted with cheap, quick-drying black paint or waterproof varnish. Cut the sheets from edge to centre

and, the plant being set, slip a piece of paper round it and keep it down flat with two or three stones or clods. The grub, it is claimed, will not crawl on to these papers, which, with care, will last several years, as they can be taken away after a week or ten days.

THE CABBAGE MOTH.

Plutella cruciferarum, Zell.

The Cabbage Moth is an introductin from Europe and from thence it has migrated, in one way or another, to every clime where cabbages and other cruciferous vegetables are cultivated. In some of these countries it is more destructive than in others, and I believe I may say with safety that, for the present, at any rate, it is not of great importance as a pest in this. The eggs are laid upon the plants by the moth, and from these small, green caterpillars in a short time make their appearance, and feed upon the leaves, often leaving little of them but the stem, ribs and veins. Having fed to repletion, the caterpillar, now a bright-green colour, spin a lace-like cocoon and pupate within it; emerging therefrom as small greyish-brown moths. This pest is generally referred to in England as the Diamond Back Moth, a name which originates from the diamond-shaped arrangement formed by the lighter-coloured areas of the fore-wings when brought together in a state of rest. (*See Plate XIV., fig. 3*).

Remedies.

Spraying with Paris green when feasible, or with a solution of coal-tar water (1lb. of coal tar to 100 gallons of water) which must be applied several times during growth to be effective. Good cultivation and use of manures, to force a rapid growth, mitigate the mischief of the pest to a very great extent.

THE GRAIN MOTH.

Gelechia cerealla, Oliv.

In addition to the attack of weevils, not a little damage is often done to stored mealies by the Grain Moth. This pest has long been known in Southern Europe and has now spread to most parts of the world. Its attack upon grain is not unlike that of the weevil. Indeed, many think that it is the moth that lays the eggs which produce the weevil, but this is a fallacy, as the eggs of moths can produce but moths, and from weevils' eggs only weevils can come.

The eggs of this insect are often deposited on the cobs whilst still in the field, and the small caterpillars which hatch out from them burrow their way into the grains. When it is full grown the caterpillar spins a cocoon in the grain and emerges therefrom as a small, greyish-brown moth, which in a very short time lays another brood of eggs to carry on the destructive work. (*See Plate XIV., fig .4*)

Remedies.

A very practical recommendation for the treatment of this pest has been given by an American entomologist, Mr. F. H. Chittenden. He recommends storing the grain in bulk and keeping it well stirred by shovelling or agitating it by other means. This is claimed to be productive of the best results, as the moth is so soft and delicate and easily crushed, that it is unable, when buried beneath a large mass of

grain, to extricate itself. Another treatment is fumigation with bisulphide of carbon. This is perhaps the simplest and best where the grain is stored in tanks or airtight bins. The bisulphide is a colourless and heavy liquid which possesses a most disagreeable smell. It volatizes readily and, the gas being heavier than air, sinks rapidly. The liquid should, therefore, be placed in shallow pans above the grain, so that the gas, sinking down, will destroy the insects. In using it it must be borne in mind that the fumes are very explosive, and no light or fire should ever be brought near, either when applying or when airing the bin or tank. It may be used at the rate of 1½ pounds to the ton of grain. One pound to the hundred bushels, it is said, is sufficient to destroy all insects, even in open cribs. Should it be impossible to treat in closed tanks or bins, by the aid of tarpaulins, oilcloths, canvas and blankets, and a little ingenuity, grain can be easily treated.

One point to carry in mind with regard to grain and granary insects is that many will come into the granary or store-house from the fields outside. This should always be prevented, as much as possible, by having the doors to fit tightly and any other openings or vents covered with fine wire gauze.

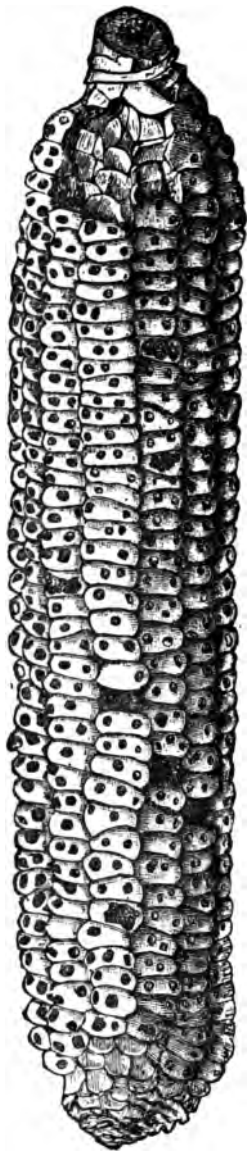
Explanation of Plate XIV.—1, Tomato and Mealie-cob worm (*Heliothris armiger*, Hübner); fig. *a*, egg, side view, enlarged; fig. *b*, egg, top view, enlarged; fig. *c*, full-grown worm; fig. *d*, earthen cell containing pupa; fig. *e*, moth with wings spread, natural size; fig. *f*, moth at rest, natural size.

Fig. 2, Full-grown worm eating tomato.

Fig. 3, The Cabbage Moth (*Plutella cruciferarum*, Zell.); fig. *a*, larva or worm, enlarged: figs. *b*, *c*, enlarged views of single segment of larva; fig. *d*, pupa or chrysalis, enlarged; fig. *e*, cocoon, enlarged; fig. *f*, moth with wings spread, enlarged; fig. *g*, wing of dark variety; fig. *h*, moth at rest, enlarged; fig. *i*, cremaster of pupa, greatly enlarged.

Fig. 4, The Grain Moth (*Gelechia cerealella*. Oliv.), fig. 1, larva or grub; fig. 2, pupa; fig. 3, moth all enlarged.

(Figs. 1, 2 and 3 from Department of Agriculture, U.S.A.; blocks loaned by C. P. Lounsbury).



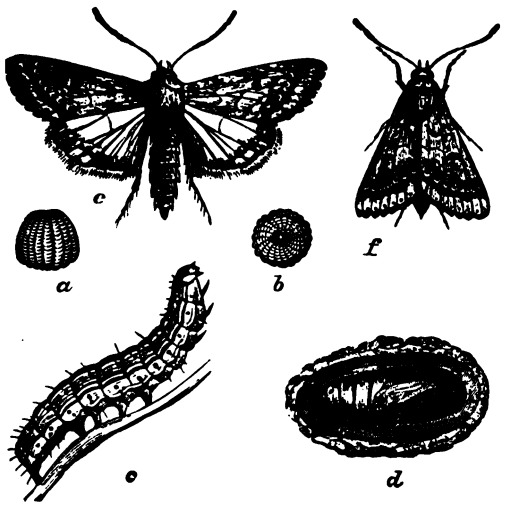
Ear of corn showing work of Grain Moth. (From Riley in Annual Report U.S.A. Department Agriculture, 1884.)

THE POTATO AND TOBACCO MOTH.

Gelechia solanella, Boisd.

As a potato pest this insect is well known in many parts of the world and also as a pest of the tobacco plant. It infests the leaves,

PLATE XIV.



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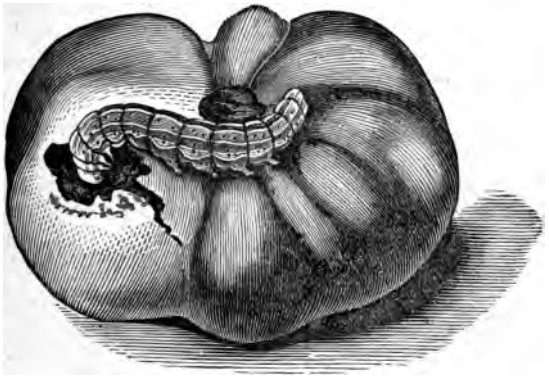

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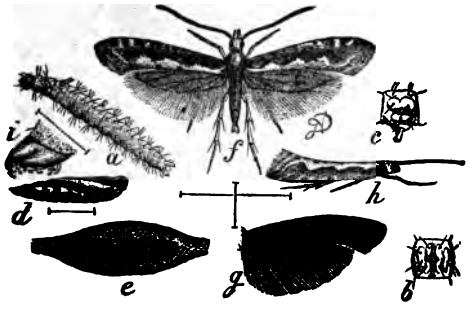

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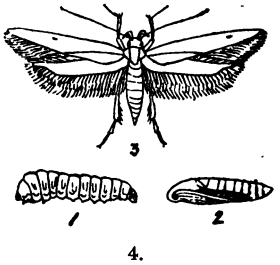
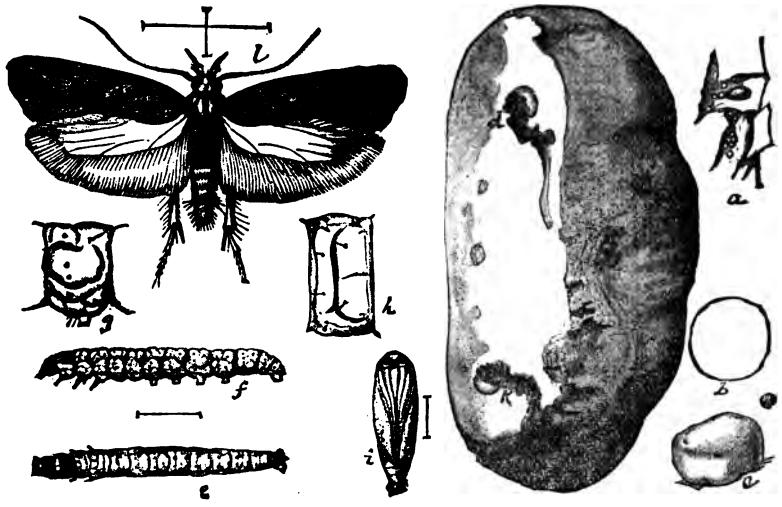


4.

Destructive Moths.

haulms and tubers of the potato, and tunnels into the leaves and stalks of tobacco. The damage it does to the former crop is usually confined to the tubers, but I know of cases where a considerable amount of harm has been done to the tops. The lower leaves of the tobacco plant are the part most generally attacked, but the damage, from the Natal tobacco grower's point of view, is not considerable. The caterpillars, however, occasionally tunnel round the stalk, and this weakens them in such a manner that a number of plants are blown down by the wind. The greatest mischief, however, is done by the insect to stored potatoes; these, as a rule, have been infested when put away and the moths continue breeding in them, the caterpillars tunneling through and through the tubers and destroying them utterly.

The adult insects are small moths of a greyish-brown colour and about ½in. in length. They may often be seen rising from the plants in numbers as one passes through a field of potatoes or tobacco. The eggs are laid upon the surface of the plants or the tubers, and the young caterpillars, on hatching, eat their way into the tissue. When full grown they measure from one-third to half an inch in length, and are of a pale yellowish or white colour. At this stage they burrow just beneath the epidermis of the leaf or tuber and there pupate. In this climate there is a succession of broods throughout the year and the insects are to be found in all stages during summer and winter. Growing potatoes become infested through the eggs being laid upon tubers that are exposed, or which the moth can reach through crevices in the lumpy soil. It is also claimed that the eggs are laid upon the haulm of the potato and, hatching there, the young larvæ make their way to the tuber. This may occasionally be the case.



The Potato and Tobacco Moth (*Gelechia solanella*, Boisd.); *a*, piece of potato tuber showing eye and eggs deposited about it; *b*, egg, top view, greatly enlarged; *c*, egg, side view, greatly enlarged; *d*, *k*, tunnellings of grub in potato; *j*, pupa at end of tunnel, seen through the potato skin; *e*, grub or larva, top view; *f*, the same, side view, both enlarged; *g*, *h*, views of segments of larva, much enlarged; *i*, chrysalis or pupa, enlarged; *l*, the moth, about three times natural size. (From U.S.A. Department of Agriculture; block loaned by C. P. Lounsbury).

Treatment.

The first measures to be considered are precautionary, and it is thought that a more level cultivation and the keeping of the surface

soil in a fine tilth, will prevent the attack upon tubers in the ground. Our farmers are, I know, not favourable to level cultivation; I believe, however, that the practice of tilling could be considerably and with advantage modified, not alone as a preventive of moth attack, but also as a method towards securing a better crop.

In the case of stored potatoes, if these are infested when taken from the field and just tumbled into any outhouse, the infestation will become worse and worse, until the tubers are valueless. Moreover, badly-stored potatoes, even when put away sound, are liable to become wormy unless measures are taken to keep the moth away from them. With the aid of a little hessian or cheese cloth this should not be difficult.

The attack on potato-tops and tobacco seldom calls for attention, but on farms where the moth is troublesome it would be a great advantage to mix Paris green with Bordeaux Mixture when spraying for the blight. For this purpose 1lb. of the poison is mixed with every 150 gallons of the mixture.

* * * * *

BEETLES.

Order *COLEOPTERA.*

It has been pointed out in the introduction that the insects belonging to this order are recognised by the hard, horny wing-cases which cover a pair of membraneous wings. These membraneous wings are used in flight, but when the insect is at rest they lie folded and hidden beneath the horny cases. Beetles are not easily confused with any insects except certain bugs, and then their chewing mouths at once separate them from the bugs, whose mouth parts are all suited to sucking. Another feature is to be found in the arrangement of the wing-cases (quite apart from the fact that only the upper half of a bug's wing-case is horny), for in a beetle the wing-cases meet in a line, down the middle of the back, whilst in a bug these upper wings overlap each other considerably. Beetles in their general appearance differ considerably from one another and these differences have given the student power to arrange them into families. A knowledge of the families is often a key to their habits; although there is always some member of one or the other with abnormal habits, just to show that exceptions prove the rule. It would be quite impossible to enter here into any discussion of the 80 different families into which they are divided and but the briefest mention can be made of those to which belong the several insects which we have to discuss.

The Chafer Beetles.

These beetles form an important division known as the Lamellicornes, the name having special reference to the lamellate or leaf-like construction of the antennæ. The natural histories of the many species which are more or less troublesome in Natal are as yet practically unknown. Without doubt, however, they are analogous with those of many similar kinds studied in other countries. From this we may infer that the eggs are deposited in the soil by the female beetles. From these hatch thick fleshy grubs, many of which grow quite large in size, and are well known to anyone who has turned over a dungheap, or done any ploughing. The grubs are usually of a white or yellow colour, with the posterior end bent downwards and swollen, so that when turned up they are curved and lie upon their sides. They feed as a rule upon the roots of grasses and other plants, and many of them remain in the soil for several years. The pupa or chrysalis is found at various depths in the soil, enclosed in an earthen cell. The adult beetles feed upon fruit, flowers and leaves, the different species having different tastes in these matters. Among our local Chafer Beetles mention may be made of the following:—

The Large Wattle Chafer (*Hippopholis sommeri*, Burn.)—This insect makes its appearance very regularly, I am told, in the month of December, and defoliates the plantations of wattle (*Acacia mollissima.*) There is nothing of a practical nature that can be done when large trees are infested throughout a plantation, as I fear the remedy would prove more expensive than the damage done by the beetles, from which, at any rate, the trees recover. In a young plantation, where the trees are but a few feet high, perhaps the best method to adopt would be hand-gathering. This beetle is about ¾in. in length, the body being of a yellowish-brown colour, and the head and thorax dark brown. (*See Plate XV., fig. 3*).

The Small Wattle Chafer (*Monochelus calcaratus*, Burn.)—

This insect differs considerably from the above, being much smaller, and characterised by the length of the hind legs. The body measures three-tenths of an inch in length.

Many similar beetles as well as this are often to be found during the spring and summer months, infesting veld flowers and as this one feeds chiefly upon the flowers of the wattle, it is hardly a pest of great importance.

The Fruit and Flower Cetonids.

Three kinds of these beetles, in company with one or two less common species, are abundant during the summer in orchards and flower gardens, where at times they do considerable mischief. The damage they do in orchards is mostly confined to very ripe fruits and so, where the fruit is marketed regularly, they have little chance. In the flower garden, however, they are much more troublesome, and the attack can only be met by constantly gathering the beetles and killing them. For this purpose it is just as well to have a tin half-filled with water and a little paraffin oil floating upon that.

Protaetia (*Cetonia*) *impressa* is by far the commonest species around Maritzburg. It is a somewhat oblong beetle, measuring four-fifths to one inch in length and half an inch in width. The ground colour of the beetle is black, with a greenish tinge, and this is relieved by broad bands and markings of light yellow. It makes its appearance before Christmas and is common until the end of March, rare individuals being found until the end of April. (*See Plate XV., fig. 1.*) About March a second species is generally found in company with it. This is *P. sinuata*. *P. rufa* var *cincta* is a beetle of a uniform olive-green colour, which is found more commonly on flowers near Ladysmith.

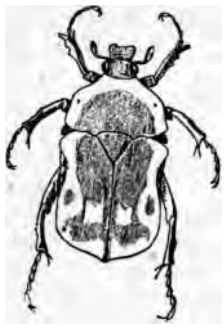
Other cetonids which have been found upon fruits are *Rhabdotis aulica*, Oliv., *Plæsiorrhina plana*, Wied., and *Melinesthes umbonata* G. and P.; and in this connection it is interesting to again refer to *Macroma cognata*, an intense brown insect, with rich yellow markings three-quarters of an inch in length, which feeds upon mealy bugs and soft scale, and is an abnormal member of this group of beetles. (*See Plate XV., fig. 2.*) So far, nothing of the early stages of these cetonid beetles has been observed by me.

Blister Beetles.

These insects are represented in Natal by a variety of beetles belonging to the genus *Mylabris*, which whilst commonly found upon garden and veld flowers, at the same time damage fruit and particularly leguminous crops. Pea flowers are, I believe, a very favourite food and, if I am correctly informed, around Maritzburg it is useless to sow this crop later than August in consequence. (*See Plate* XV., *fig. 5*).

Among the more common species may be mentioned *Mylabris transversalis*, Mass. and *M. omega*, two yellow and black insects and *Lytta velata*, Gerst., a grey insect. *M. transversalis* is a conspicuous insect, one inch in length. The antennæ are yellow and the body and legs black, except that the wing cases are marked at the base by a small round yellow spot and two broad bands of the same colour, extending right across them. *M. omega* is usually about half the size of the former, and somewhat similarly marked, except that the yellow spot of *omega* is represented by a curved or lunate band. These insects are common upon flowers throughout the summer and are recorded as at times destroying fruit. *L. velata* is a small grey beetle about half an inch in length, which has been sent to me as destroying potatoes and lucerne.

PLATE XV.



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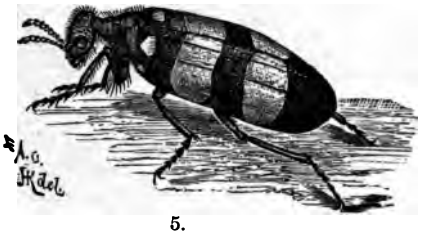

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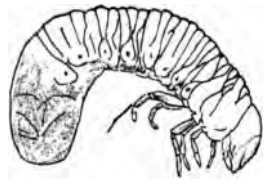

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Nothing has yet been ascertained regarding the early stages of these insects; they belong to the family of Blister Beetles (*Cantharidæ*), and are supposed to have similar properties. They are, however, never used for the same purpose, although the Kafirs use longicorns as love muti.

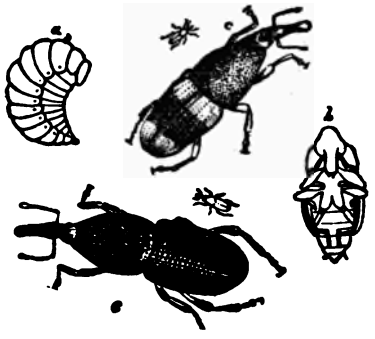
WEEVILS.

The weevils or snout beetles are distinguished from other beetles by one very marked character. This is the extention of the head in front in the form of a more or less elongated muzzle or snout, which carries the mouth at its extremity. They are, as a rule, more destructive in the grub or larval state, tunnelling in the fruits and stem, or woody parts of plants, or in vegetable matter. The grubs are stout and footless.

The Grain and Tobacco Weevil.

Calandria oryza, Linn.

This is the only weevil pest of any importance which I have as yet observed. It is very small and known the world over as an active agent in the destruction of stored grain. Upon the coast it has been noticed as destructive to stored leaf-tobacco, cigars and corringas in the drying and storehouses of tobacco growers. As its name *oryza* signifies, it is more properly spoken of as the Rice Weevil and it is supposed to have come originally from India in that grain. The adult weevil measures from one-eighth to one-sixth of an inch in length and is longer than wide. It is of a dark brown colour and has four dull, red spots upon the wing cases. The eggs are laid in grain, cigars, etc., in a hole made by the insect with its snout-like mouth. In the case of attack upon grain this may occur, according to the observations of others, in the field, but more usually in the granary. A small, stout, footless maggot hatches from the egg and feeds and burrows in the grain or tobacco as the case may be. It pupates without leaving its feeding ground and emerges therefrom as an adult weevil. These adults are very general feeders, and have been found in numerous substances. According to Chittenden, they will invade biscuits, cakes, macaroni, flour, meal, and sugar, and over-ripe fruits, and in many of these I have observed them in Natal.



Grain Weevils.

Treatment.

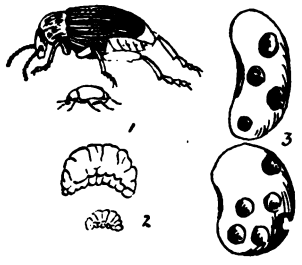
For treatment see under Pseudo-weevils.

Explanation of Plate XV.—Fig. 1, the Flower Chafer (*Protaetia impressa*); fig. 2, the Mealie Bug Chafer (*Macroma cognata*); fig. 3, the large Wattle Chafer; (*Hippoyholis sommeri*); fig. 4, characteristic Chafer Grub; fig. 5, the Bean Beetle (*Mylabris transversalis*); fig. 6, the Fig-tree Longicorn (*Phryneta spinator*); fig. 7, the Amaryllis Weevil (*Brachycerus labrusca.*) Figs. 5 and 6 loaned by C. P. Lounsbury. Figs. 1, 2, 3, 4 and 7 original.

Pseudo-Weevils.

The pea-weevils or Bruchus beetles are not weevils at all, but belong to a very different family; still they have many habits in common with and are usually spoken of as weevils. Several kinds of these insects have been observed in Natal destroying stored peas and beans of the cow pea and lima-bean varieties. The first attack of the insects is supposed to be whilst the beans are still in the pod, the maternal insect gnawing an entrance and depositing its eggs. After this, in any case, generation after generation will breed in the one lot of beans or peas and, if they are stored sufficiently long, nothing may be left but dust and dead insects.

Whilst about the same dimensions as the grain weevil, mentioned above, these beetles, however, differ considerably in appearance. The body of the weevil is long and narrow, but that of the Bruchus is, compared with it, short and stout, being as nearly wide as long. The head is differently placed also, being bent downwards so that it can hardly be seen when looking down at the insect from above; moreover, it is not elongated in the form of a snout. In its natural history it resembles the grain weevil, the grub or maggot being footless and the pupa period spent within the bean.



Pseudo Weevils.

Treatment.

The purchase of infested seed should be strictly avoided. In case of a purchase being afterwards found infected, the good can be readily sorted from the bad by throwing the seed into water, when the bad seed will float on the surface and the better sink. Several methods are recommended for treating injured seed and perhaps the best course to pursue is to fumigate with carbon bisulphide, for use of which see under note upon Grain Moth.

It is also recommended to soak the beans or peas for 60 seconds in boiling water, when the insects are killed without the germ being affected. If immersed over 60 seconds, the germ is likely to be destroyed. Heating to 135 to 150 degrees F. has also been recommended.

Other Beetles.

There are, in addition to these, but few beetles of much importance as pests to cultivated plants and up to the present no observations have been made in connection with those destructive to forest trees. Among such others as have come under my notice mention may be made of the following:—

The Coffee Borer (*Monochamus leuconotus*).—I am indebted to Mr. J. F. Queckett for adults of this borer and for specimens from Blantyre, B.C.A. The larva has been observed several times in coffee, but no investigation of its natural history has been feasible. It is an insect which was in great abundance towards the end of the old coffee-growing days of the Colony, I am told, and with *Hemaelia vastatrix*, the coffee disease, has the credit of expunging the industry of coffee raising. Looking backward and comparing the old methods of coffee growing with the modern, it is not difficult to believe that these methods were more the root of the evil than either disease or beetle.

THE FIG-TREE LONGICORN, (*Phryneta spinator*, Fab.).—This is a fairly large insect which has been sent me on one or two occasions as destructive to the bark of fig trees. It is not, however, credited with doing much damage, nor is it at all common. Lounsbury also records this species from the Hex River Valley, C.C., as eating bark from young wood of fig and pear.

PALM BORERS (*Oryctes baas*, Fabr., and *O. monoceros*, Olio.).—During December last Mr. Medley Wood sent me specimens of these two species, which he thought were destroying his *Phœnix* palms. Being in Durban a few days later I examined the palms and found that the damage was being caused by the adult insects burrowing their way into the heart of the growing apex of the palm, and there feeding upon the flow of juice set up by their mischief. Some three or four beetles had attacked each palm, the burrow in all cases being made from the outside.

AMARYLLIS WEEVIL (*Brachycerus labrusca*, Gylh.).—My attention was first drawn to this insect at Mr. A. Allkins' place at Verulam, where it was found in great numbers during October eating down the amaryllis plants, and keeping them level with the ground, despite the fact that the weevils were gathered every day. Upon digging up some of the bulbs the root of the evil was unearthed, for there were found feeding upon the bulbs the fleshy maggots and in small earthern chambers the chrysalids. This beetle is a fairly large weevil, five-sixths of an inch in length, and nearly half an inch across the widest part of the body. The abdomenal region is much larger than the head and thorax and is covered with conical protuberances. The thorax is prolonged and pointed on either side, and the snout broad and stout. With the exception of certain yellow markings upon the legs and a large yellow area on either side of the thorax, the body is a dull black. (*See Plate XV., fig. 7*).

Apate terebrans, a black insect, about $\frac{3}{4}$in. in length and with a cylindrical body, has been noticed doing considerable mischief to pomegranates at Verulam, by boring into the trunk and stems. In the latter the tunnels extended for a considerable distance, one to two feet, and the branches, being weakened, broke off with the weight of the fruit. In this attack it was only the adult beetle which was doing the damage, the attack being made from the outside.

* * * * *

FLIES.

ORDER *Diptera.*

The technical name *Diptera* signifies that the insects belonging to the order are to be distinguished from other insects by their possession of one pair of wings. From a study of their anatomy it appears that originally flies had four wings, but that the hinder pair have disappeared and are now represented by a pair of slender balances or halteres only, which have the form of slender clubs. As a rule, the wings of all flies are devoid of scales and hair and are more or less transparent. They are usually very distinctly marked with longitudinal veins, which run from the base towards the apex. Typical flies are among the most common of household insects and many of them are destructive in their habits. A large number, however, perform useful functions as scavengers, and others again as parasites or by preying upon other insects. I have only referred somewhat in detail to the Fruit Fly and to the Horse Bot Fly in this report, but we have several other species to which it is hoped attention may be paid at a later date. Of these may be mentioned the Pumpkin and Melon Fly, *Dacus* sp., the Man-infesting Fly (Maggot Fly), the Sheep Bot, *Œstrus ovis*, and the Tsetse Fly of Zululand.

THE FRUIT FLY.

Ceratitis sp.

ORIGIN AND DISTRIBUTION.

This insect ranks a good first among fruit pests in Natal. It is impossible now to say whether it is an introduction into the country or not. It has been known upon the coast belt as far back, I believe, as old colonists can remember and is simply credited by them with being worse nowadays than then. It is only during the last 20 to 30 years, however, that it has been known in Maritzburg, and whilst it has spread out from here in all directions, it is still, I am assured, unknown further up country than a distance of about 150 miles from the coast, between Mooi River and Estcourt. It is said, however, to be gradually extending its range all over the Colony. Judging from the numbers of them which have appeared this season in the districts immediately above Maritzburg and knowing that it thrives as well at such elevations as 2,000 feet, 3,000 feet, and 5,000 feet (Botha's Hill, Manderston, Maritzburg, Mooi River and Highlands) as upon the sea level, there can be no doubt it will ultimately be distributed over the whole of the Colony.

The insect belongs to the same genus as the Fruit Fly of Cape Colony (*Ceratitis capitata*), which it greatly resembles. The Cape Fruit Fly is a more or less cosmopolitan insect, being found in many other parts, including the Mediterranean, the Bermudas, the Canaries, Mauritius, Western Australia and New South Wales; and, taking all things into consideration, it is very curious that it does not occur in this Colony as well. It is also equally remarkable that the Natal species has not been reported from the Eastern Province of Cape Colony, considering the almost similar conditions which prevail and the constant interchange of fruits between Durban and Port Elizabeth and East London.

Though I am personally inclined to regard our species as of local origin and a native of the coast, President Verral, of the London

Entomological Society, regards it as *C. frenicillatus*, Bigot, an insect originally reported from the Gold Coast (W. Africa).

Host Fruits.

The Natal fruit fly has a very wide range of fruits upon which it feeds in the larva stage and these have been ascertained by actually rearing the flies from them. The list includes the following: Plums (all sorts), peaches, apricots, nectarines, apples (russet), oranges, mandarins, mangoes, loquats, seeds of *Solanum giganteum*, "um-Tongaans" (*Chrysophyllum natalense*), red china-guavas and yellow guavas. I have also been informed that they attack quinces, figs and persimmons, and it is quite possible that time will reveal further hosts.

Method of Attack.

In all cases the adult female fly punctures the fruit by the aid of her ovipositor and, with the same organ, deposits her eggs beneath the skin or rind. This organ is really the last segment of the abdomen and, in its construction, is specially adapted for the purpose of penetrating the skin of the various fruits, which are to form the nidus of the brood of maggots hatching from the eggs there laid. The number of eggs deposited in one puncture varies, though 4 to 6 were usually found in cases coming under my immediate observation. A fruit may, however, be stung in several places and consequently it is no uncommon thing to find a dozen or more maggots in a single fruit. This applies particularly to large peaches. There is, I regret to say, a great amount of egotistical opinion with regard to pests and their habits in Natal; and there are many who will not accept the indisputable fact that this insect pierces the fruit, but hold that it lays its eggs in holes, etc., made by moths and other insects, in which opinion they are quite wrong.

The progress of the maggot through the pulp of the fruit is marked by a softening of the tissue and general decay, in stone fruits more particularly than in apples, quinces, etc. In these the decayed area is not so general, being restricted more to the immediate vicinity of the tunnels which the maggots have worked. The maggots feed by means of a pair of powerful jaws. These are black in colour and may be seen with the naked eye.

Life History, Habits, etc.

The egg of the fruit fly is white, about $\frac{1}{8}$in. in length and not half that in breadth. In shape it has been likened to a torpedo. The eggs hatch within a short period after they are laid. This I have found to extend over two whole days, but it is no doubt often much shorter. The number of eggs laid by a single female has not been ascertained, but, judging from the numbers found in the ovaries of an allied species, it may reach four dozen. The maggot is usually white or of a yellow colour, the head being indicated by the black jaws. Occasionally the colour of the food will show through the body. and I have noticed that when feeding in pink guavas the maggot acquires quite a pink colour. They are of the usual maggot-like shape, being cylindrical, pointed at the head and blunt behind. When full fed they invariably seek the soil in order to pupate. They may even pass from the fruit and fall to the soil whilst it is still hanging upon the tree, a circumstance which has been noticed in the case of yellow peaches

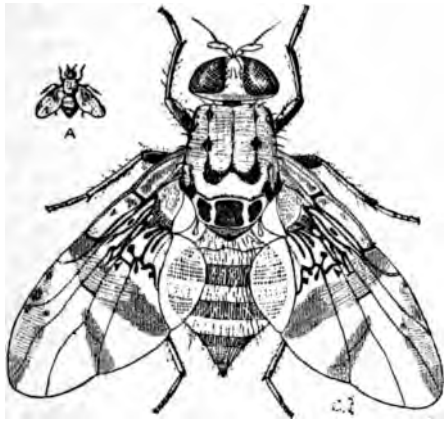
at Hillcrest and one which is common to some other fruit flies. Generally, of course, they pass out from the fallen fruit into the soil and pupate immediately beneath the fruit. The time taken by a maggot to mature, after the hatching of the egg, is naturally difficult to ascertain with any degree of certainty and it is a period which must vary in length according to the season. The pupa is a stout, egg-like body, one-fifth of an inch in length, and one-tenth in diameter, and rounded off bluntly at each end. They vary, as the insect matures, from a golden brown to a dark red-brown. In summer this stage lasts ten or twelve days, but my observations do not extend very far as regards the early and later parts of the season, nor am I able to say whether the pupa stage ever lasts over the winter. The pupæ are seldom found at any depth in the soil and the majority lie within an inch of the surface. The adult of this species has a general resemblance to *Ceratitis captitata*, but the male is without the spatulate appendages to the head. In size and intensity of markings the insects vary somewhat in relation to the host plant. Thus, taking those from peaches as normal, those bred from guavas are more robust and more strongly pigmented, whilst those from loquats and um-tongwaanas are quite small. The length of the body in the normal flies is ¼in., the expanse of the wings being ½in. Between the eyes, the head is of a yellowish or creamy-white colour; the eyes, in life, a metallic blue or green; antennæ, yellow; style, yellow at the base and the remainder black. The back of the thorax is grey and more or less faintly marked in front, the scutellum being black, margined with light yellow and divided into three equal parts by two bands of similar colour. The wings are transparent and irridiscent, the basel portion is tesselated with dark veins, beyond this area is a broad transverse band of yellow and smoky black. A little beyond this a similar band runs along the costal margin to the tip of the wing, and a third smoky band originates between these in the centre of the wing and extends to the inner margin. The six legs are yellow throughout in the female fly, but the male insect is characterised by having the lower half of the tibia furnished. on either side, with combs of stout, short, black hairs. The abdomen is short and stout, divided into four coloured areas by two traverse bands of silvery grey and two of brownish yellow.

Methods of Prevention.

There is no cure, in the common acceptance of the term, for the attack of the pest and infested fruit cannot be saved. From a perusal of the life history and habits it will be seen that there are few opportunities presented for taking measures against the insect. Owing to their position within the fruit, the eggs and maggots are invulnerable to the effect of any application in the nature of a spray and, in the passage of the latter into the soil and during their subsequent pupation, there is practically little that can be done to kill them. The adult flies offer even less opportunity to destroy them, nor is there any encouragement to be gained by the results of the experiments conducted against allied insects, with similar habits, in the matter of trapping or preventing them visiting the fruit, by any simple means.

For the present, then, it only lies within my power to recommend two courses. The first consists in picking up all fallen fruit daily in the orchard and the gathering of all perceptibly-stung fruit and de-

Explanation of Plate XVI.—Fig. 1, the Fruit-fly, A, about natural size; fig. 2, the pupa, A, natural size; fig. 3, the maggot or larva, A, natural size.



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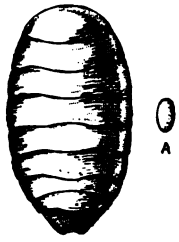

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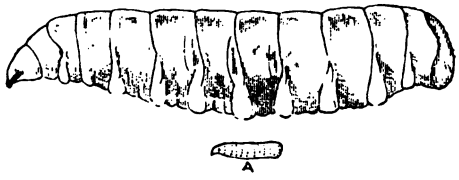

3.

Claude Fuller, del.

The Fruit Fly.

stroying it at once. One of the simplest means of doing this, which recommends itself to me, is to bury the fruit and pack hard over it ten or twelve inches of soil. It is a very common thing to recommend the feeding of maggot-infested fruit to pigs and this I am quite prepared to acquiesce in, if fed to them in troughs. The usual practice is, however, to throw the fruit into any part of the sty and whilst on the whole, I suppose, the bulk is eaten, generally, I fear, many of the maggots escape from the fruit into the ground and go through their transformations in the usual course. If a thing of this nature is worth doing, it is certainly worth doing well. The other course is to cover in the fruit with netting and so prevent the female flies gaining access thereto to deposit their eggs. This course I can safely recommend for any choice fruit, if only upon account of the high figures which are obtainable, particularly for stone fruits. To farmers and others growing a few fruit trees about the home, the netting is cheap and most useful.

The origin of this method rests with Mr. C. P. Lounsbury, Government Entomologist of Cape Colony, who introduced a specially-cheap line of mosquito netting from the United States of America, and adapted it to this purpose. Since then large quantities have been used throughout the Cape Colony and not a little in Natal. The netting can be obtained locally from Messrs. Steel, Murray and Co., at 1s. 9d. per piece of 8 yards by 6 feet.

The expense and inconvenience of netting is against its general adoption, but I may be forgiven if I quote an instance illustrating its value from two points of view. A grower once consulted me and said it was necessary to devise a cheaper and less troublesome means of protecting the fruit than netting, and instanced a case where it cost him £1 to net a single tree. The tree, however, "netted" him £6 worth of fruit, which otherwise would have been destroyed. I in my innocence, regarded this as a testimonial in favour of the practice, but the owner of that tree could not see eye to eye with me—

Fruit Trees covered with netting to keep off Fruit Fly infestation.

Wintering.

An interesting and important point in connection with this pest, which requires some elucidation, is in what stage and manner it passes through the winter. Take, for instance, an isolated farm at

Mooi River, (4,500ft.), where there are fruit trees at least two or three miles from any others. Here the flies will appear in the fruit. In the early fruit a few, and in the late peaches many. They will commence in December and finish about April, and then, for seven months, they will not be seen, though it is possible that the presence of a few oranges and mandarins may help them through that period.

Another instance to which my attention was called was the case where a fairly isolated orchard and those in the neighbourhood were entirely stripped of their fruit by hail whilst it was yet green, and yet the fly was as bad, if not worse, next year than it had ever been.

Both these instances are from farms at an elevation of over 3,000ft., where the winter is sufficiently cold to ensure some kind of hibernation.

In this connection I may quote the following letter from Mr. H. W. Boast, Magistrate of Bulwer, which expresses a phase of the question which is endorsed by others. Under date of January 18th, 1900, he writes: "I am quite convinced that the dense foliage of evergreen trees is excellent shelter for this fly, particularly the lemon, loquat, wattle and, best of all, the blue gum. By experiments I have proved conclusively that, by having no evergreens near deciduous fruit trees and digging up the soil in autumn after the trees have lost their leaves, you kill the insect in the pupa stage and the trees, being leafless, afford no protection. It would be most difficult to keep a loquat free from the insect, because it is an evergreen. You may dig up the soil and destroy the insect in the ground, but the fly still remains in the shelter of the tree. I have come to the conclusion that the loquat is a most dangerous tree in the orchard for this reason. A curious thing about the fruit fly is that it does not exist in the 'Thorn Country' in many parts of the Colony, especially the Mooi River thorns and the highlands in Weenen County. It does not (or did not, perhaps I should say) exist in Klip River County, including Ladysmith."

THE HORSE BOT FLY

Gastrophilus equi, Fab.

The Horse Bot Fly is not of uncommon occurrence in Natal, and both the eggs, which are deposited in the month of April and the larvæ or bots found in the stomach, are well known to most farmers. No studies in the natural history of the species have been undertaken here, and as I am only able to review this from the published reports of investigations undertaken elsewhere, no apology need be offered for so doing, and no doubt the habits and natural history of the species are the same here as elsewhere.

Writing of the injury done by bots, Herbert Osborn* says: "Different writers have placed very different estimates upon the injury due to bots, and as great diversity, or perhaps greater, exists in the opinions of practical men and veterinarians, some holding that the presence of the bot in the horse's stomach does not interfere with its normal activities, whilst others look upon them as extremely dangerous and sometimes refer almost any serious disturbance of the digestive organs, or death from unknown cause, to bots." For myself, I am unable to give any opinion upon the subject, but incline to the belief that the presence of bots, as they sometimes occur, in very

* Bull. 5 n. sr. Div. Ent.; U.S.A. Dept. Agric. "Insects affecting Domestic Animals," by H. Osborn.

great numbers, is not conducive to the well-being of the infested animal and I hold that the parasite is treated all too lightly, and measures to prevent its increase too much neglected. I certainly for one do not entertain the idea that bots are conducive to the well-being of a horse.

Life History.

The eggs are about one-sixteenth of an inch in length and yellow in colour; each end is somewhat pointed, that which is attached to the hair of the animal being more pointed than the free end. The free end is furnished with a small cap, which is broken off by the young maggot when emerging. The eggs are attached to the hairs of the shoulders, forelegs and sides of the body, and where, as a rule, they are likely to be licked off. With regard to the hatching and vitality of the eggs, the following conclusions arrived at by the writer quoted above, after careful observations, are of great interest:—

1. The eggs do not hatch except by the assistance of the horse's tongue; though it is quite possible, but unusual, for them to hatch without moisture or friction.

2. Under ordinary circumstances hatching does not occur until 10 or 12 days, and possibly longer, after they are deposited.

3. Hatching takes place most readily after a fortnight on to five weeks after being deposited.

4. The majority of the larvæ, within the eggshells, are dead after 35 to 40 days, but some may retain their vitality and show great activity on hatching as late as 39 days.

The newly-hatched maggot, according to Osborn, is a slender, transparent, worm-like creature, and at first probably feeds upon the mucous secretion of the mouth and œsophagus.

Upon reaching the stomach it fastens to the wall by the hooks with which it is provided and undergoes a considerable change, assuming the form so well known to farmers. When full grown it measures three-fourths to an inch in length and is of a somewhat conical shape, the head being pointed and the abdomen truncate, whilst the segments are furnished with a row of well-developed spines. The growth of the bot occupies a considerable time, say from April through the winter until the following summer. It now loosens its hold and is carried through the intestines and passes out with the excrement, from which it burrows into the ground and enters the pupa stage, which is said to last for a month or 40 days. At the end of this period the flies make their appearance. (*See Plate XXV., figs. 6 and 7*).

The adult bot-fly is about ⅝in. in length, the wings being transparent and marked with dark spots and an irregular band across the centre. The colour of the body—which is densely clothed with hairs—is brown, the abdomen being ornamented with rows of dark spots. The males differ from the females in lacking the two tubular segments at the end of the abdomen. They are, however, seldom seen, whilst the females are often noticed whilst depositing their eggs. This action is a very rapid one and the egg is deposited and glued to a hair whilst the fly seemingly but makes a dart at the horse.

Treatment.

The treatment of this pest should clearly be of a preventive character, and it is far more important to prevent the introduction of the bots to the stomach than to treat them when located there. Indeed,

were every farmer to do his best to destroy as many eggs as possible during the short period in which they are laid, the pest in most districts would, after a few years, become of little account. The eggs are so conspicuous that they cannot be overlooked and what has often surprised me is the callous indifference with which many farmers will allow a horse to go literally covered with them. The control of the Horse Bot should not be a difficult matter in Natal, where but few horses are allowed to run so long as to become unmanageable.

We have seen too from the observations quoted above that a considerable period elapses between the deposition and the hatching of the eggs, and from these observations it is not difficult to arrive at the conclusion that the removal or destruction of the eggs once a fortnight will be a sufficiently effective treatment and will prevent a horse from suffering to any great extent from the parasite.

FLEAS.

ORDER *Siphonaptera.*

Fleas, it is pointed out in the introduction, belong to a separate order of insects; although until recent years they have been considered as belonging to the *Diptera*, or two-winged flies. They were so placed because of a pair of minute scales upon either side of the thorax, which were taken as representing wings. There are, however, considerable and important structural differences between fleas and flies.

Except in certain habits, size, and anatomical character, all fleas are very much alike. The body is always much compressed or flattened from side to side, so that the animal is able to travel quickly through the hair of its host. The legs are well developed, particularly the basal joint and this gives them the great leaping power which characterises nearly all species. The mouth is specially adapted for piercing the skin of warm-blooded animals and for suction. Fleas pass through three phases of existence from the egg. These latter are usually deposited amongst the hairs of its host, or about its sleeping place or nest. The larvæ, or maggots, which emerge from these eggs, are usually minute and very active. Their bodies are remarkably slender and wormlike, and sparsely clothed with hairs. They are to be found feeding on decaying organic matter in the dust and debris of the places frequented by the host, favourite places being covered calf-pens and fowl-houses. Here also the pupa period is passed. Among the more common fleas found in Natal are those infesting dogs, calves and fowls; and, occasionally, these are found in huge numbers upon certain farms. Their presence is entirely due to neglect and they are at times such a scourge that there is much difficulty to at first make any impression upon their hoards. Still, anything like a systematic endeavour will overcome them. In the first place, their breeding grounds must be discovered and thoroughly cleaned out. Covered stables, littered down for calves, are usually alive with fleas, and it requires little patience to unearth, in these places, the maggots in abundance. Such stables should be thoroughly cleaned out and the floors scraped until all is dry and hard. The debris can then be burnt and the interior well syringed with some carbolic dip or paraffin emulsion, upon several successive occasions. An occasional spraying or syringing and the keeping of the floor clean and hard, will reduce the nuisance to a minimum. In infested fowl-houses and nests cleanliness will do much to mitigate the evil, as the maggots of the fleas are always to be found in the dust, droppings and straw of dirty houses and nests. Dog and cat fleas are controlled in the same way by furnishing pets with regular sleeping quarters and keeping these latter clean and dusted, once in a while, with insect powder.

THE JIGGER FLEA.

Sarcopsyllus penetrans.

This insect has seemingly become established in the Colony during the last few years. It is difficult to ascertain at the present moment the actual date of its arrival, but it was known to several that the kafirs working at the Bluff in 1897 and subsequently making the rifle range at Durban were troubled with these parasites. It is only during the last twelve months, however, that there has been any general

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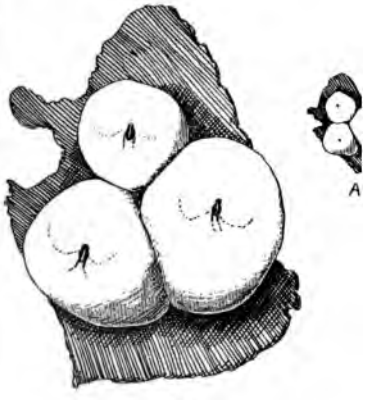


3.

The Jigger Flea.

notice taken of it, and there is no doubt that it has, within that period, become more widely distributed and abundant. So far it is practically confined to the coast-belt, but there is no reason why it should not extend up country now, as cases have already been noticed at Botha's Hill. There seems little doubt that the fleas were brought down by natives from Lorenzo Marques, and they are now particularly common amongst the plantation Indians. Some painful cases have come under my observation among these people; and I am given to understand that so many were affected at Esperanza that work on the estate was seriously handicapped. Other than one case of attack upon pigs, little has been heard of the fleas attacking animals.

The Jigger Flea, or chigoe (*Sarcopsyllus penetrans*) as it is variously termed, is supposed to have reached Africa from America, having appeared at the Congo upon the opposite side of the continent in 1872, from thence it is said to have travelled across to the east coast and to have come down here from Zanzibar. Very little authentic information seems to have been acquired concerning the details of its natural history. and up to the present I have not had any opportunity of prosecuting observations which would add to what is already known.

The adult male and female jiggers are not unlike ordinary fleas and irritate their hosts in the ordinary manner. The female is supposed to penetrate the skin after she has become impregnated; in the case of man, usually selecting the thicker-skinned parts of the foot. Having effected a lodgment, nothing but the posterior extremity is seen in normal cases; she now becomes so distended with eggs that the body is quite round and cyst-like and about the size of a pea, the head and legs being relatively so small that they appear only as specks upon the white body. The flea lies beneath the skin and fits tightly into the cavity it occupies. Exactly how the larvæ develop under normal conditions, I do not know. They are in the form of small slender maggots like those of other fleas, and are supposed to escape from the sore or tumour ultimately caused by the presence of the parasite and to develop as do other fleas in refuse and dust. It is generally believed that if a female be crushed in the skin, these maggots will escape into the surrounding tissues, and greatly increase the inflammation and injury. It is a curious fact that this is a pest of the foot of man, and that this portion of the anatomy is chosen whether he be a booted European or a shoeless coolie. (*See Plate XVII*).

Treatment.

The attack of this parasite is not difficult to treat. As, up to a certain stage, there is little irritation or inflammation, it is usually recommended to leave the flea until it is fully distended, and then to extract it by first breaking away the skin around it with a needle and taking it out bodily. If the cavity is then carefully washed, using a little Condy's Fluid, or other antiseptic, in the water, it heals readily. In many cases, however, the parasite can be safely dealt with by opening the small tumour and squeezing out the contents; the wound thus made must be carefully dressed with antiseptics, it being usual to wipe it out with a little cotton wool wet with such.

Explanation of Plate XVII.—Fig. 1, the male Jigger Flea; fig. 2, the female Jigger Flea before entering the skin; fig. 3, inner portion of a piece of human skin with three swollen Jigger Fleas *in situ*, the same is shown natural size at A. (Figs. 1 and 2 after Arnold Cooper; fig. 3 original).

The following letter from Mr. H. Brickhill, Phœnix, is of interest in connection with the appearance of the Jigger Flea in 1897:—

"With reference to your request for any information re Jigger Flea, I may say I first heard of it in the year 1897 as giving the natives over at the Bluff a great deal of trouble; these natives were nearly all from Delagoa and Zanzibar and I feel confident the flea was brought from up the coast, as some of these boys I had working for me, whose feet were rather badly burrowed, told me they had it in their country.

"It spread very quickly among my boys and eventually I had my turn, and upon more than one occasion I have taken out the flea, evidently before any change had begun to take place and also after the eggs had been deposited. I turned to "Waterton's Wanderings in South America," where I remembered having read of this flea and found that he put a drop of turpentine into the cavity after extracting the bag; but as his method of extraction was somewhat of a 'business,' I did not follow it out, but simply opened the top with a needle and squeezed the eggs out. I then put a drop of turpentine into the hole, and did not suffer the least inconvenience afterwards.

"Of course, it is different with a native's foot; owing to the hard skin, and its corrugations, it is difficult to find where the flea has burrowed, so as to tackle it in its early stages, and that is, I consider, why so many natives get crippled."

PLATE XVIII.

Locusts killed by Fungus.

LOCUSTS, CRICKETS, etc.

ORDER *Orthoptera.*

The term *Orthoptera* signifies "straight wing" and refers to the longitudinal folding of the hind wings of the various insects composing the order. Many of these have popular names and are well known, for besides the two familiar groups named in the above title, cockroaches, grasshoppers, Hottentot gods and stick-insects are also members of the order. With the exception of the Hottentot gods (*Mantidæ*) the orthoptera are all more or less injurious. The chief characteristic of these insects is found in the wings, the two pairs differing in their structure. The forewings being tough and serving as covers for the more delicate hind ones.

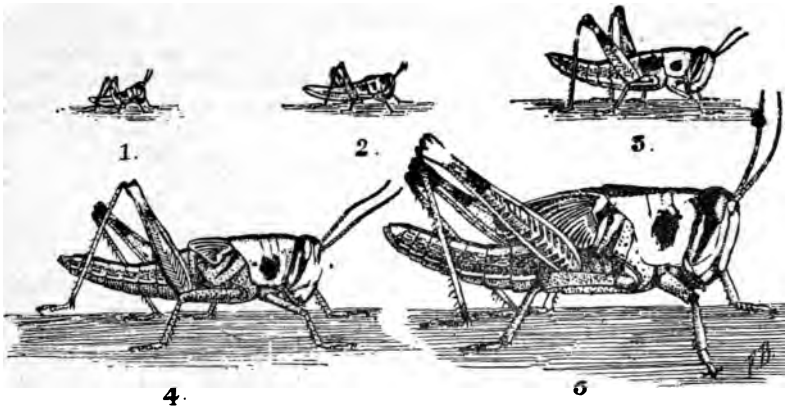
In Natal there are a large number of destructive orthoptera, including several locusts—the "Totofianas" for instance—which I find myself unable to touch upon in this report.

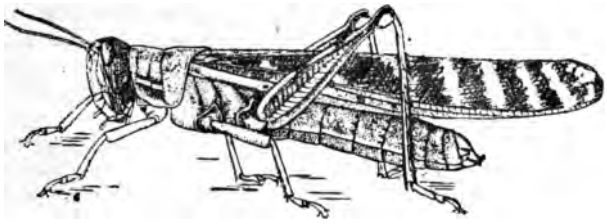
THE PLAGUE LOCUST.

Acridium pupuriferum, Walker.

The locust plague of late years has assumed an entirely different phase in Natal to what the years 1895-6 saw. Locusts have now taken rather the position of an important and destructive pest upon the coast belt, and fallen from the high estate of a national to a domestic question. Strictly speaking, Natal is not a natural habitat of this locust, for, unlike the Cape, we have but the one species, *Acridium pupuriferum*, and it had not been seen here for very many years prior to the invasion of 1895. Within the recollection of old colonists, however, there was some fifty years ago a huge invasion, quite, from all accounts, in comparison to the more recent one. The locusts did not, however, do the mischief they have since done, nor did they acquire the foothold they now have. Of course, in those days there did not exist the fields of cultivated crops that are to be found to-day and so the same amount of damage was out of the question. This fact is also regarded as, in a measure, responsible for the locusts not making any great sojourn; for they did not find such large areas suitable for depositing their eggs in, and went elsewhere. Then again, I believe, the swarms blown out to sea were enormous and, furthermore, the young which did hatch out where the pest laid upon the coast, were swept out of existence by the guinea-fowl, which in those days were very numerous. With regard to the invasion of 1895-6, I regret to say that most of the official records of the campaign conducted against them were destroyed in the Town Hall fire of 1898, so that no account of the action taken by the Government can now be given.

At the present time the locusts which do the mischief are produced locally. and not from visitant swarms. That is, of course, if we recognise Zululand upon the north, and Griqualand upon the south, as within the locale. The eggs are laid during December and January, there being usually two and sometimes three successive layings in the central districts of the coast, though not of course by the same swarms. These eggs hatch out in the course of five to six weeks, and the earliest winged swarms appear during February and March, or 60 to 70 days after hatching. These flying insects remain about the





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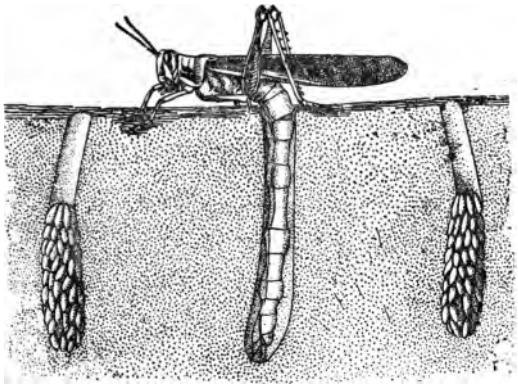

7.

(*Adapted.*)

The Plague Locust.

country, travelling shorter or longer distances, with a tendency to migrate northwards during winter and southwards in the spring.

The pest and its habits are so well known that there is no particular necessity for detailing observations here. Amongst parasites and natural enemies, mention may, however, be made of the Locust Bird which is said to at times consume large numbers and of the Locust Fungus, to which attention was first drawn by Mr. Arnold Cooper, of Richmond and who also (and not Dr. Edington of Cape Colony) was first instrumental in having this fungus cultivated upon a large scale and distributed by the Government.

Of internal parasites and parasites of the egg, I have seen none but the *Gordius* worms, which on occasion have been found in large numbers. There is, I am given to understand, a parasite of the egg, but this, so far, I have not met with. The *Tachina* flies, which are credited with destroying many swarms in Cape Colony and other parts of Africa, do not appear to exist in Natal.

Reverting to the Locust Fungus, it may be safely said that whilst a large number of insects die annually from its effects, there are a number of planters who do not admit the efficacy of its artificial distribution. Unfortunately, it is not an easy matter in practice to actually prove or disprove this contention, but there is much evidence to show that when conditions are suitable to the growth of the fungus, it has been successfully used, particularly where locusts which have already died from the disease have been used for carrying the contagion. There is one phase of this question which has not been thoroughly thrashed out and that is, what are actually the most favourable conditions for the rapid development of the fungus. It is generally claimed that warm, muggy or damp weather is required, but, as a matter of casual observation, I cannot help noticing that when the fungus has killed off large numbers of locusts, it has been subsequent to a considerable fall in temperature for several days.

With regard to the name of the fungus, it is competent for me to say that some amount of doubt exists as to its true position. Professor Galloway, of the U.S.A. Department of Agriculture, placed it as very nearly allied to, if not the same fungus as, *Mucor ramosus*, whilst Mr. Chas. French, the Victorian Entomologist, writes me that it has been determined as *M. racemosus* by Professor McAlpine of Victoria. Through Mr. Lounsbury I have also been privileged to see correspondence from an official at Kew, England, to whom he had sent material for determination. The information Mr. Lounsbury received was to the effect that the fungus was a new species and would be worked out and described.

By far the most successful method of dealing with the locusts in the Colony has been by poisoning the hoppers or wingless locusts with arsenic and treacle; the many devices so commonly employed elsewhere for catching the locusts in hopperdozers or by driving them against screens being, upon the whole, impracticable in so hilly a country. Originally this poison was distributed from paraffin tins with brushes made of a bundle of twigs, but this crude and wasteful method is being supplanted by the spray pump, whose use at once showed a saving in labour, transport and material of 70 to 80 per cent., the pump preferred for the work is the Galloway knapsack, fitted with

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Explanation of Plate XIX.—The Plague Locust, (*Acridium pupuriferum*). Figs. 1 to 5 showing the gradual development of the wingless locust; fig. 6, adult locust; fig. 7, female locust depositing eggs. (Figures modified and adapted from L. Bruner).

the cyclone nozzle. This successful poison was originally discovered by Mr. Gilbert Wilkinson, of Ottawa, and very little credit has he received for it except amongst his immediate neighbours. Some little while ago Mr. Wilkinson favoured me with a letter describing how he came to use the arsenic, and, as a matter of historical interest, I reproduce it here.

Writing under date of September 10th, 1900, he says:—"I think it was the year 1894 we first had the locusts, and our mode of attack was in surrounding the swarms of hoppers with a gang of men armed with switches, made of wire (as used to bale up fodder), cut into lengths of about 2ft. 6in., and fastened together at one end for about 6in. to form a handle. The men worked towards the centre, beating down the hoppers and as the centre was approached, odd men would fall out and form another outer circle and kill those which had escaped. After a time the hoppers got scattered and our next move was to give each man a sheet of galvanised iron; arriving at a spot where locusts were plentiful, the sheets were placed end to end, with slight overlap on the ground, each sheet being supported by a stake driven in the ground. This formed a barrier two feet high, and in length proportionate to the number of men employed. The men would then form up in skirmishing order and drive the locusts from 200 to 300 yards towards the screen. I forgot to mention that along the edge of screen holes were dug in the ground, about 2ft. by 2ft. by 2ft., with about 4 to 6 inches thick of trickle placed in the bottom. The locusts towards the finish of the drive would fall into the holes and be suffocated by the treacle, which clogged their breathing orifices under the wings. When the drive was over the screens were removed to other parts. Tons of insects were destroyed in this way, but it made no appreciable difference to the plague.

"However, the holes led me on to experiment. I noticed whereever the holes were saturated with treacle and the dead in heaps alongside, the survivors would remain and any fresh swarms would be arrested in their progress by the smell of the treacle. They seemed to hang about sucking at the ground and eating up their dead friends. I then used the treacle as a bait with different poisons. One was a weak solution of cyanide of potassium, but none were a success, not until I used a solution of arsenic, made with carbonate of potassium. I found the above alkali too expensive, however, for practical purposes and so used caustic soda as a dissolving agent.

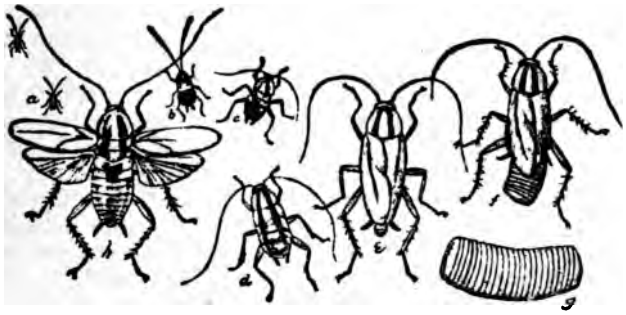
"About ten days after I had made use of arsenic, treacle and boiled sweet potatoes, mashed and placed along the cane roads in little heaps, the estate was practically clear; the boundaries then being the only parts liable to attack, my cane fields commenced to look green, whilst my neighbours could not boast of a single leaf. Many planters came to see the results, but it was not till the following year that they made use of the poison. Now, however, I believe it is used on all the sugar estates. Of course, many improvements in the mode of application have since been made. After the first year I simply sprinkled the treacle mixture on grass or trash where the swarms were and found it quite effective. As to the danger incurred in the use, I think there is no more, and perhaps less, than in the use of many sheep dips containing arsenic."

Latterly the use of a simple soap solution has been adopted with success. This was, I believe, used with success in Cape Colony and was first adopted here by Mr. Robbins, Stock Inspector at the Tugela, whose work has been carried on with the approval of the Department of Agriculture.

COCKROACHES.

FAMILY *Blattidæ*.

In common with other lands, we in Natal have our share of these particular "bugs," almost every house rejoicing in a supply of the larger or smaller variety. The larger variety—which has not been determined—is an insect allied to the Oriental roach (*Periplaneta orientalis*), and the smaller is the German roach (*Ectobia germanica*), and whilst both species are almost equally common, the two are seldom met with together. The smaller species is known in the United States as the Croton bug, a name derived, according to the writings of Marlatt, from its early association with the Croton waterworks system of New York, and the larger species is familiar to English colonists as the "black beetle."



The Small German Cockroach.

Cockroaches are more annoying than destructive and the particular "bete noir" of the housewife, not alone on account of the way they overrun all her wares, but also on account of the unpleasant start they give her upon opening a drawer, or on entering the kitchen or pantry overnight. In the matter of diet, roaches are not at all particular and little in the way of animal or vegetable matter in a dry state comes amiss to them. One happy trait is, however, credited to them and that is their reputation of feeding upon the bed bug. This I find is very generally believed throughout the Colony, though on no occasion have I been able to verify it myself. If the statements to this effect are true, I do not think that they apply in any large measure to the German roach, as far as Natal is concerned. I am led to this conclusion from observations made in a residence where both the vermin existed in sufficient numbers to throw doubt upon that particular virtue of the roach. Cockroaches resemble locusts in their manner of growth, that is, that after hatching from the egg the young resemble the adult except as regards size and the possession of wings. The following excellent description is taken from the writings of Marlatt, quoted above and which may be easily verified by any reader of these notes: "In their mode of oviposition cockroaches present a very anomalous and peculiar habit. The eggs, instead of being deposited separately, as with most other insects, are brought together within the abdomen of the mother into a hard horny pod or capsule, which often fills the body of the parent. This capsule contains a considerable number of eggs, the number varying in the different species, arranged in two rows, the position of the eggs being indicated on the exterior of the egg by transverse lateral impressions.

When fully formed and charged with eggs, the capsule is often partly extruded from the female abdomen and retained in this position sometimes for weeks, or until the young larvæ are ready to emerge. The capsule is oval, elongate and somewhat bean-shaped, and one of its edges is usually serrate. On hatching, it is said, the young are often kept together by the parent and brooded over and cared for, and, at least, a colony of young will usually be found associated with one or two older individuals."

Treatment.

Within my own experience of the small German roach, I can safely say there is nothing like a systematic hunting of the insects and scalding out of their haunts with boiling water. I have seen it confidently asserted that borax and sugar spread about is a very useful poison, but I have had no success with it and some weeks after I spread it around, in picking up the paper bag still containing half a pound of powdered borax, I made a haul of over a hundred roaches, who were simply revelling in it, eggs, young. and all. The same remark applies to a bag of powdered alum, except that there were more roaches in the alum than in the borax. Indeed, my experience showed me that there is nothing in the way of roach traps that can be compared to a paper bag containing some dry food-stuff. It must be screwed close at the top and left untouched on a top shelf for a week or so. Other traps, fanciful things sold by the ironmonger, are very disappointing. With the bigger roach I have no experience, but Mr. E. Saunders, of Tongaat, says he finds nothing so effectual as bagasse soaked in arsenic and treacle solution, as used for locusts.

Fumigation with carbon bisulphide of chambers which can be well closed has been recommended by the American writer quoted above. In fumigating rooms with hydrocyanic acid gas, I was greatly surprised at the capability the small roach has for withstanding this gas. It is by far the most effective means of reducing the numbers of the pest and I regret that, owing to the highly poisonous nature of the materials and of the gas, I cannot recommend it to any but those who have some practical experience in its use. Dusting their haunts with insect powder overnight and sweeping up the paralyzed insects the next morning several times in succession has also been recommended.

WHITE ANTS.

Termes spp.

To use a colloquilism, there are no end of white ants in Natal and, from the coast to the berg and onwards, their hard clay nests or termitaria are to be found affording cover to the scout and a camp-oven to the field cook in this time of warfare. Common, as they are, however, and the species numerous, practically nothing is known of them. In other parts these insects have been more or less tentatively studied, but here we have an unworked field. The damage they do is great, but the question of their economy as tillers and aerators of the soil has never been entertained. This interesting phase of their economy must, however, be passed over in our present knowledge of the subject; nor need we recapitulate the nature of the damage done to those for whose information these notes are written.

White ants, as most of us are aware, are not ants at all, having no affinity to that group of insects. They belong to quite another

natural order and, simulating ants somewhat in appearance and the habit of living in communities, are correctly spoken of as Termites.

In their natural state, so far as I have been able to ascertain, our white ants live upon grass or decaying vegetable matter and upon fallen timber. Their nest, or termitarium, as it is called, is always either below the soil, or is in the form of a mound from a few inches to six and ten feet in height. Of the inhabitants of the nest, we know that the queen is the most important and the largest. She is usually found in a special chamber erected for her accommodation. Here she lies through a lifetime, fulfilling the one object of her existence in laying eggs with which her abdomen is so enormously extended that she is many times larger than her subjects, and looks like a small white sausage. Food is carried to her by the working population of the hive. In company with the queen, writers who have studied these creatures tell us, there is a royal male or "king." The subjects consist of two classes, "workers" and "soldiers," which are modified larvæ of both sexes, whose growth has been arrested and who are blind.

Early in summer, when the rains start, we all become acquainted with the myriads of Termites (flying ants) which swarm in the evening air and see the small boys catching them for bait, and the kafir for food. These winged insects are males and females which have left the nest. After flying for some time they drop their wings and, mating, serve the purpose for which they are produced by supplying kings and queens for future colonies. The duties of the "workers" need no explanation and the "soldiers" have but soldiers' work to do and defend the hearth and home.

Remedies.

The measures to be taken are solely preventative. In planting out an orchard, every nest inside its limits, at least, and as far outside as possible should be destroyed, care being taken to secure the queen. This is not an easy matter I know, still it repays one well to do the work thoroughly. In winter it is often feasible to burn a great deal of the nest out with the aid of paraffin, and no doubt a lot could be done with the aid of carbon bisulphide, which should be poured into a hole made in the nest by the aid of a crowbar.

To actually protect trees from ants is a very difficult matter, as their attack is not consistent, a tree being taken here and there; and when the tree is young, the mischief is done before it is noticed. Should the trees be large and the ants seen to be working about their base, it may be possible to destroy them or drive them away by soaking the ground around the base of the tree with some contact insecticide, such as a weak solution of paraffin emulsion, or any of the non-poisonous sheep dips. For this purpose the Government Entomologist of Victoria recommends Quibell's mixture, one part to fifteen of water, about a quart being used to each tree.

The invasion of houses by these insects is only met with by most drastic measures once they have effected a lodgment, and usually they cannot be got rid of without removing all the invaded woodwork. The presence of white ants in a number of Colonial houses is to be accounted for by the dry grass used in the mud plaster (dargai). In building wooden places special precautions against these pests should always be taken. Several of the Australian hardwoods and other timbers are not favoured by Termites and these should always

be employed as much as possible. In Australia it is a very common thing to see wooden houses built, clear of the ground, on piles; the piles being covered on top with a sheet of galvanised iron or zinc. The object of this is to prevent them passing up into the timbers of the houses. In view of the fact that these insects eat their dead, it is no uncommon thing to dress timbers with poisonous chemicals "Anti-Ant Washes," as they are colloquially named. One of the best of these is, I understand, prepared with arsenic and soda dissolved in rock oil (petroleum). Such dressings cannot, of course, be permanent in their effect.

BUGS, APHIDE AND SCALE INSECTS.

ORDER *Hemiptera.*

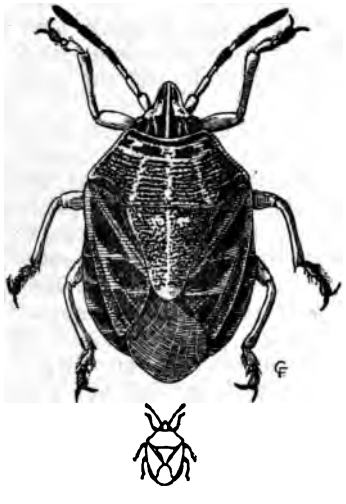
This order contributes largely towards the numbers of our injurious insects, besides including several of a beneficial nature and some of commercial value. The name *Hemiptera* meaning "half wing," is suggested by the form of the fore or upper pair of wings in the plant bugs, but the order is composed of two or three well-defined groups. These, however, all agree in two essential features. In the first place the insects go through an incomplete metamorphosis, that is, as pointed out before, they do not change their general form very much in development and do not enter into a resting stage such as the chrysalis stage of a butterfly. In the second place the members of all three divisions have the mouth-parts suited for piercing and sucking.

The characters of the plant bugs, or true bugs, as they are called, have already been alluded to in the introductory chapter to this part; those of the other divisions are touched upon later on.

THE COFFEE BUG.

Antestia variegata, Thurb.

This insect I have not seen outside a coffee plantation in Natal, although it is of common occurrence and an all-the-year-round fruit pest about Capetown. From a well-known coffee grower, the Hon. Thomas Kirkman, I understand that the insect often occasions considerable loss of berries upon his estate at Equeefa, by puncturing them and so causing them to fall. About twelve months ago also, I received specimens of the same insect from Mr. Maurice Cox, of Cholo, B.C.A., who wrote for information concerning them; there having arisen in that part of the world a curious controversy as to what the insect really was, many claiming that the bug was a ladybird, and considerable doubt being thrown upon the real cause of the destruction to the berries. Subsequently I was favoured with an eight-page pamphlet, published by the Central African Times Press, entitled "The Cameron Discovery."* This is a well-known brochure, giving a succinct account of how the author, Mr. Kenneth J. Cameron, made the "Discovery of the cause of the Spotted and Light Berry." As the case is stated so plainly by Mr. Cameron, and his observations so much to the point, I take the liberty of quoting some of the most interesting parts of his report for the benefit of local coffee growers and those interested in the subject.



The Coffee Bug.

*The Cameron Discovery. "Discovery of the cause of Spotted and Light Berry," by Kenneth J. Cameron, with a note by the Editor of the *Central African Times*, Blantyre, B.C.A. August, 1889.

The Cause of Spotted and Light Berry.

"I have no doubt but that planters like myself who know a little about agriculture and who have been sometime in this country, have been at a loss to comprehend the reason why some plantations have given such bad results, especially after giving a promising display of maiden crop, perfect and sound in every bean. The following year the quantity may be greater, but the quality has decreased considerably; not that all the beans are bad, but there is an admixture of bad beans which cannot be properly extracted and which reduces the value of the whole crop. The third year may be worse, and the plantation seldom reaches the perfection of bean given by the maiden crop.

"Several reasons and theories have been given as to the cause of this damage, among these the dry climate, bad pruning, the spotted or speckled bug, the want of tilling the soil, etc., etc.

"To a certain extent the remedies to counteract these supposed reasons and wants have been tried, and the results so far are not encouraging. Irrigation has been tried, pruning or handling has received attention, the spotted bug has been sent home for examination, chemical manures have been applied, we are now getting shade trees planted, cattle and other manures have been tried, and the tillage of the soil is no new experiment in B.C.A.

"One of these reasons has not received the attention it should have. I allude to the spotted bug. True, it has been sent home for examination, but has it been given to an expert? Even with all the suspicion against them, no planter has gone the length of clearing his plantation of them, so far as I am aware, even as an experiment, and no planter has studied its habits so as to ascertain what it lived on. Possibly we can all give excuses why we did not do so. They were very plentiful at Mandala when I arrived there, and I think it was about a year after that I noticed some flower buds that some insect had been eating. The bugs were there, and I naturally put the blame on them.

"As soon as they made their appearance here I determined to watch them. This was no easy matter, for as soon a I endeavoured to get within reach of them they seemed to be aware of my presence, and were on the alert, some running in among the berries, others behind the leaves, others disappeared by falling, and others remained watching. I saw one bug, as I thought, having a drink of coffee through a proboscis. I caught it and examined it, but the proboscis disappeared. I caught another under the same circumstances and examined it also, the probiscis again vanished. I took a pin and raised the antennæ, while I held the bug upside down between my fingers. After raising the antennæ here was the proboscis lying flat, and right between the hips, or, as it were, hid under the antennæ. I next examined the coffee berries which had been probed by this proboscis. I squeezed some berries between my fingers, and watched where they had been probed. Some berries exuded a drop of sap, and the younger berries squirted out juice like a syringe. The hole made by the proboscis can hardly be detected by the eye. I also examined the inside of the berries, probed and found them the same as if they had been wounded. I continued watching these bugs and could distinguish the hair-like proboscis between its legs.

"I have watched four at one time imbibing coffee, with my watch in my hand, for twenty minutes, but I had to give it up before they were finished, and therefore cannot tell how long they take to a

drink. Their excrement appears almost transparent, like water, or a slightly green coloured gum, and looks not unlike dew or raindrop on the leaves or berries below which they have been drinking.

"I have never noticed this bug anywhere else except on coffee, and they do not appear unless the coffee is in fruit. The greatest number of bugs found on one plant here was over twenty, young and old.

"These bugs fix or lay their eggs on the berry, on the leaves, on the dry or withered leaves that fall off the plant, and on bits of dried grass, weeds, or stones found below the coffee, The number of eggs found in one group varies from ten to sixteen, the most common number being twelve. The greatest number of eggs found on one plant and round and under it was 115, and this only in a very hurried examination, but this is quite sufficient to show with what rapidity they multiply. The egg is about the size of a mustard seed, perhaps less, and when first laid is almost white or slightly yellow; but, as it ripens it turns a little dark-blue, caused by the colour of the bug inside, the shell remaining pure white. The egg opens with a lid, and they are placed generally on the lowest part of the berry, and in this way the eggs are upside down. This is just a cup and saucer to hatch young coffee bugs in, but not to drink coffee with. The egg corresponds with the eggs found in the abdomen, and the number found there ranges from ten to eighteen.

"Watch the coffee bug while it is imbibing coffee liquid, and as soon as it is disturbed you will notice it lift up its body. This is to extract its proboscis, and it sometimes does it so suddenly that it fails to retain hold of the berry. This may be accidental, or on purpose, for it falls down and has a better chance of escape. When you try and catch them they sometimes fall, so that it is always best to put the hand underneath. On letting them fall from the hand they, as as a general rule, fall to the ground and try to hide under leaves or in crevices in the soil, but some fly to other plants a few yards away. I have noticed one of these bugs cast its skin, and its colour was afterwards much paler, but it only remained so for about a day.

"This bug has been mistaken for the ladybird beetle (Coccinella), but when examined properly there is a great difference. The ladybird beetle belongs to the Coleoptera order of insects, which are mandibulate, or have horny jaws, while the coffee bug belongs to the Hemiptera order, or the haustellate group of insects, which feed on the juices of animals (common bug) or plants, and they imbibe this juice through a powerful sucking appartus.

"Now the damage these bugs do is something enormous. Not only are they the cause of spotted, or what is sometimes called chipped, beans, but as far as my observations and experience go, they are also the cause of empty berry. The worst plantation I have seen with empty berry this year had these bugs in abundance, and at Mandala these bugs and empty berry went together. The coffee berries from the young stage, and until they begin to get yellow, are in a liquid and semi-liquid stage, and it is quite reasonable to calculate that they must damage, or empty considerably, more in a young state than when they are full grown, and as the skin is only pierced and receives no other damage, it is quite possible it may grow to full size while the berry is empty. It is only when the beans in the cherry (or what is left of them) begin to harden that the spot is caused, as it is more solid, and cannot be sucked except from the part nearest the proboscis. This so-called chipped berry has often been blamed against the pulper by people at home, but we in B.C.A. know otherwise. We know the spot

is caused before the bean goes to the pulper. Beans that are spotted, or are not solid below the parchment, yield or break as they are being pulped; but good beans are seldom damaged by the pulper. Had the skin of the coffee berry been succulent like the inside, then it would decay much sooner when it is pierced by the bug, just as the soft inside decay. The skin, however, especially in the young stage, is not unlike bark, and is able to resist some damage; while the berry, on the other hand, being in a liquid stage is easily contaminated. Some fruits when ripe are succulent, and the least damage to one part of the fruit (such as a peach) is sufficient to injure the whole, but in coffee the riper the beans are the less damage can be done to them.

"The question now is, How are we to get rid of them? I see no remedy except the very simple and happily practical one to pick them off by hand and destroy them. The smallest (native) children can do this, and can be encouraged by rewards for the largest amounts brought in. A little water in a bottle would probably be the best receptacle for them when being picked. This will be more satisfactory than picking damaged beans out of our crops, an almost impossible process. Once a plantation is thoroughly cleaned of these bugs, I think it will be an easy matter to keep them clean afterwards.

NOTE BY THE EDITOR.

"Mr. Cameron's discovery is new and yet old. Bugs have for years been known in English agriculture as the enemies of the farmer, and even in coffee planting every planters dreads the mealy bug, the white bug, black bug, etc. The spotted or speckled bug, however, is unlike these others, and to most people it is like the English ladybird under which name it was for long known and referred to in correspondence. It will be found referred to by the late J. Buchanan as a bug "not unlike the ladybird beetle in appearance," and he states that "the mischief resultant upon its visitations is often serious, empty berry, diseased bean, and in some cases no crop at all." It was also referred to by Messrs. H. J. Gardiner, in a later report, as the probable cause of spotted bean and empty berry, but just when we were beginning to pay serious attention to it, a report came out, we forget from whom, stating it was no bug, but a ladybird and a friend to the planter, as it would feed on scale insects. The matter then subsided, but no one had ever got the length of proving that this animal fed on the berry. Mr. J. Buchanan was quite ignorant of how the animal effected the damage, although he, along with many others, even up to the present day, have always suspected that this bug or "ladybird" was the cause of the damaged bean. In proof of this, no one has ever cleared his plantation of the bug, nor taken extensive steps to combat them. It has been left to Mr. Cameron to prove by demonstration that the bug actually feeds upon the berry.

"At the present time the bug will not be readily found. During June and July they copulate, and after laying their eggs, like most other insects, they die. Nearly every planter in the country, however, knows the spotted or speckled bug, which for so long has been looked upon as the "lady-bird." As soon as the young bugs appear they should be at once caught and killed. The best way to catch them is to put the hand underneath them, and then with a slight touch they fall off.

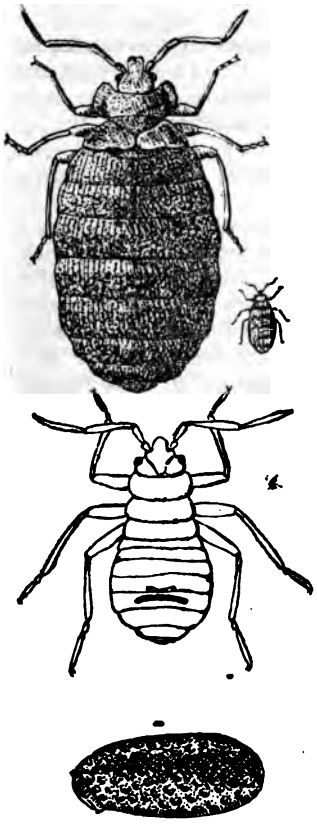
"Mr. Cameron writes:—'Up to the present I have caught over 60,000 bugs from about 6 or 9 acres." Later on the number had

reached 80,000. Supposing they had been left alone, what an enormous number would have been bred by these 80,000, which would have emptied and spotted next year's crop. Mr. J. Duncan's plantation, Upper Mudi, was literally swarming with these bugs this year, and the crop was most unsound. Much more confirmatory matter could be written, but it will be better to hold it over until planters have considered the question for themselves."

THE BED BUG.

Acanthia lectularia.

In many places throughout Natal this disgusting pest is prevalent, and it has formed the subject of many earnest inquiries addressed to this office. This regrettable state of affairs is due, in a great measure, to climatic conditions, which favour the uninterrupted increase and activity of the pest all the year round. Another explanation, of course, is the coloured population, with whom it seems to live upon the most friendly terms and, in the quarters provided in towns for coloured servants, it is generally to be found in abundance. It is, therefore, no slur upon the housewife that "mahogany flats," as the American people aptly term them, are lodgers in her home; for, despite all her endeavours, it is most difficult to get rid of them entirely. One prevailing feature in the construction of houses in Natal I have noticed as particularly conducive to the establishment of the vermin once they have effected an entrance. I refer to wooden ceilings. Most parties that are troubled with bugs are aware of this, and I have myself gathered confirmatory evidence on the point. Unfortunately, wooden ceilings constitute a Natal prejudice. I mean by this that I am assured that no other ceiling will do in this part of the world. But after some little local experience I am fast drifting to the conclusion that very many of the things which will not do, "will not do' simply because they have never been tried.



The Bed Bug. Adult, young and egg (all enlarged). After Marlatt.

Bugs gain entrance to a house in many ways. They are often found in new houses that have never been occupied, I am told, and this has given rise to the general opinion that they are introduced in the timber. This is, of course, not altogether impossible, but I rather fancy that, as often as not, they are carried into a new house by those constructing it. It is well to know that not only may one introduce the pest with luggage, but that one has always to be on the watch to prevent the increase of those not seldom brought in the weekly washing, or upon the clothes and persons of coolies and kafirs. It is quite *possible* also that they may come into the house

upon their own account, migrating from one adjoining. The inoffensive guest who comes by rail often adds unconsciously to the discomfort of a household, owing to the fact that the passenger rolling-stock of the Colony is not by any means free of this class of "dead head."

Not a little local notoriety was gained for the insect during the sittings of the Royal Hospital Commission last year, when several witnesses testified to the fact that the buildings in which the sick soldiers were housed at Fort Napier were overrun with them.

Bed bugs have been known to be associated with man, as household pests, since ancient times, and references to them occur in many old writings. To isolated countries such as England, America and Australi. they have been carried probably by the very vessels which first conveyed the white man thither. In Natal, whilst they have been introduced from time to time by Europeans, it is more than probable they have existed from early times.

Life History, Habits, etc.

The egg is white and oval, and is to be found in the cracks and crevices frequented during the day by the insects. In badly-infested houses they have also been found upon the bedsteads and even in the folds of the matresses. The young bug which hatches from the egg is not unlike the adult except, of course, in point of size. It possesses six legs, a pair of antennæ and a rostrum or beak, fitted for piercing the skin and imbibing the blood of its victim.

At first these young bugs are of a light yellowish colour, but, as they grow older, gradually assume the brown colour of the adult. In its growth the bug moults or changes its skin five times. After the last moult it is a perfect insect, and is then able to reproduce its kind. It differs from its near relations of the bug order in having no wings. During its long association with man the need for these seems to have disappeared and with it the organs; all that remains being a pair of small wing pads, the presence of which differentiate the adults from the immature. This loss is fortunate, and our gain. Bugs have several characteristics and the peculiar odour they emit in common with garden bugs is very well-known. They have credit, too, for some very clever manœuvres, and one might hazard the remark that they have picked up some of the cunning of their hosts.

The bite of the bed bug is painful and even poisonous, to some individuals, whilst upon others it is quite innocuous.

Remedies.

In a well-built house, clean and with walls and ceilings free from cracks and crevices, the extermination of the pest is little more than a thorough campaign, extending over at least a week, of daily inspections and cleanings of bedsteads and bedding, and any cracks and crevices in which insects are likely to be located. Eggs must be looked for and destroyed with benzine or paraffin—avoid insect powders, as they do little damage to the vermin and seldom act as more than deterrents for the time being.

Sulphur fumes have been strongly recommended, but those who have used this method locally do not regard it as at all effective (no doubt the wooden ceiling has much to do with this).

The washing down of ceilings from above with sheep dip I have found a very common practice in Maritzburg. No doubt it does some good, but it very often leaves nasty stains upon the walls and I cannot but believe that something cleaner in the form of paraffin or a solution of arsenic would be equally efficacious.

In Cape Colony the use of hydrocyanic acid gas was found very beneficent in the case of railway carriages, but so dangerous is the procedure in the hands of any but an experienced party, and so highly poisonous the chemicals used, that it is not possible to recommend it to the householder as a remedy lying within his or her reach.

So unmitigated a nuisance are the insects, however, that I have been tempted to try some experiments in fumigating houses. The first difficulty to contend with has been to render the rooms sufficiently air tight—a circumstance always difficult to overcome in dealing with rooms ceiled with match-boarding.

In a tentative trial, ½oz. was used to 100 cubic feet, and a considerable number of insects were found dead after two hours upon the floors. The gas had by that time diffused to a great extent and about 10 per cent. of the bugs revived. In this case, however, I feel sure both the amount of gas generated was too small and the time the room kept closed too short.

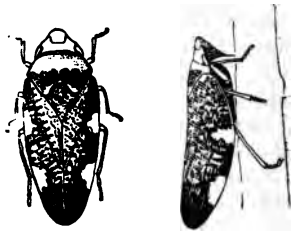
Subsequently a few insects were noticed in the room, but from being the worst infested in the house it became the least. Subsequently further trials, using 1oz. to 90 cubic feet, were made, and since then I believe there has been a cessation of hostilities upon the part of housekeeper and bugs.

THE SPITTLE BUG.

Aphrophora grossa, Fab.

This is an interesting native species which, whilst it does little, if any permanent damage during its sojourn on our peach and apricot trees, makes them very unsightly and disgusting. The insects are usually called "singers"; the singing of the cicadas, for some reason I fail to understand, being attributed to them. They do not, however, make any noise. They are homopterous insects, belonging to that division of the order *Hemiptera*, which included the aphides and scale insects.

They are common objects on peach trees on account of the immense amount of spittle-like foam which accumulates about them; and, during the whole time they are upon the tree, this drips incessantly down, forming large, wet patches upon the soil beneath. This amount of dripping I have endeavoured to guage, but with little success, as so much of it runs down the trunk and enters the soil there. In bright, thundery weather, the dripping is more rapid than at any other time, and from a single colony I have taken two ounces in three to four hours.



The Spittle Bug.

The colonies, which consist usually of a couple of dozen individuals, are always found upon old season's wood, and never upon new growth. They grow and mature together pretty regularly, gradually acquiring their wings, until the adult stage is reached. A curious fact is that whenever they are disturbed, even by the shaking of the limb, thereupon they scatter in all directions up and down the branch and later, when the danger seems to have passed, congregate again. When about to moult for the last time and enter into the adult stage, each insect retires from its comrades a little way and, having formed a shell-like, transparent dome of spittle, dependant from the under side of a twig, casts its skin. It remains in its crystal palace a little

while before entering into the active business of life, the pursuit of which consists of a series of skips about the trees and rose bushes (if there are any). and, as often as possible, a visit to a lamp or other illuminant.

These bugs, or froghoppers, as perhaps I should call them, make their appearance upon the trees about the first of November, and arrive at maturity in about four weeks' time. They remain about the trees till towards the end of January, when eggs to the number of 36 were then to be found in the ovaries of the female. After this they disappear altogether and are not seen again until the young make their appearance in nine months' time.

Where and when the eggs are laid I am unable to say, although persistent searches have often been made for them.

The immature froghopper is very dark coloured, the body being black and mottled with grey and red spots. The adult, however, is a faded-looking creature, being a pale yellowish-grey. It measures some seven-tenths of an inch in length, and may be recognised by the accompanying figures.

FAMILY PSYLLIDÆ.

The members of this family are designated Jumping Plant Lice by some writers. They are small insects, resembling aphides in the adult stage, but are more like scale insects in the earlier stages. Their mouths are adapted for sucking.

CITRUS PSYLLA.

Trioza sp.

This insect belongs to a group closely allied to the scale insects, and has received the popular designation of Citrus Psylla from Mr. Lounsbury, the Cape Entomologist, who was the first to describe it in any way. In the Cape it was found attacking the orange, lemon, citron, shaddock, mandarin and bitter Seville orange in the Eastern and Midland districts. It also infests these plants in Natal and has been spread, upon the coast-grown nursery stocks, to almost every farm in the Colony that I have visited. The insects is, I believe, a native of Natal, its original host being a species of *Cussonia*.

With regard to its natural history and habits, I need offer no apologies in giving Mr. Lounsbury's original observations in detail, the points of which I have myself confirmed. He writes:—"The eggs are generally deposited along the edges of expanding leaves. These eggs are yellow in colour and oval in form, and have a short, stem-like projection at one end. The young larvæ crawl on to the under surface of the leaf and there settle; and it appears that, wherever one settles and begins to draw nourishment from the leaf, a pit-like depression slowly forms. The young insects fit nicely into these depressions and are not especially conspicuous. They are pale yellow and bear a superficial resemblance to the young of the Brown Scale, but can be distinguished by the presence of a short and delicate fringe around the body. This fringe is composed of a great number of straight, white, waxen filaments of equal length. The eyes are reddish and quite large. Finally, these scale-like bodies develop into winged insects. These winged insects are very active, both at jumping and flying. When settled, they look, to the unaided eye, very much like ordinary plant lice. The damage done to the plant does not appear to be particularly great, and except for the unsightly mis-shapen leaves, there is no great after-effect."

Treatment.

Fumigation and spraying, at the proper season, are both successful measures; but upon young trees the surest way of getting rid of the pest, as first suggested by the writer quoted above, is to keep the pitted leaves and infested portions picked from the trees.

APHIDES OR PLANT LICE.

Family *Aphididæ*.

These are well-known insects, and all those noticed in Natal appear to me to be introductions from other countries. Several of the more common forms are described later, but besides these we have the Black Peach Aphis, the Black Orange Aphis, the Rose Aphis and an interesting species affecting the hedge plant (*Thuja orientalis*).

Aphides are all small insects and differ in many respects from the plant bugs. In their natural history are many striking features, some of which are referred to in discussing the Turnip Aphis. The winged forms have four delicate, glassy wings and upon the backs of many species is a pair of tube-like organs, through which a sweet fluid is secreted. This is called honey-dew and is much sought after by ants, bees, wasps and flies. Ants, in particular, are very fond of this matter, and certain species are said to tend aphides with as great care as man does a milking herd.

TURNIP APHIS.

Aphis brassicæ, Lin.

The turnip aphis is more generally known as the "cabbage aphis," and is often the cause of a great deal of loss in turnip fields in the Colony. Its ravages were particularly felt during last June in the crops coming on for winter feeding. This was no doubt due to the better hold the insects obtained upon the plants, consequent upon the bad summer which preceeded last winter. Turnip aphis, of course, must always be expected during the dry winter season, and the severity of the attack will vary in accordance with the season which preceded; for there is no doubt that a dry season encourages their increase, whilst at the same time it weakens the plants and makes their attack more manifest. Like a number of others, this is an imported pest, having spread originally from Europe to all countries where turnips or cabbages are cultivated. In Natal the exact life history has not been particularly studied, but we know that it, unfortunately, goes on breeding and increasing throughout the whole winter months in those parts of the Colony where turnips are grown. The aphides which first appear are known as stem-mothers. They are hatched from eggs laid by sexual females, after intercourse with males. These stem-mothers, or agamic females, multiply without the intervention of a male, and their progeny possess similar functions. As an aphis becomes a mother when about a week old and produces a large number of young day after day, it is not difficult to account for the rapidity with which they increase, so that, according to those who have investigated the subject more closely, a single aphis may become the ancestor of some millions of descendants in a short season. Most of these descendants are wingless, but a certain number are winged, and it is the winged forms which migrate from plant to plant and spread the infection.

Remedies.

A number of applications have been tried for the destruction of aphides, and paraffin emulsion and tobacco dust are spoken of as giving satisfactory results, but in the case of the turnip the difficulty is to destroy the insects upon the lower surfaces of the leaf. This fact must be borne in mind and the total extermination of the pest not hoped for in a blighted field. Several parties have tried paraffin emulsion at my suggestion, but the relief was only temporary. In these cases, however, the fields were badly blighted and it was really too late to adopt any treatment.

In correspondence from this office, it has been usual to recommend the gathering and destruction of plants showing early signs of the fly, as a means of preventing the attack as much as possible, as well as sprayings of nicotine sheep dip, or applications of soot and lime (air-slaked). Frequent sprinklings with air-slaked lime, or a mixture of this with soot or fine road dust, are recognised as an effective treatment. Writing of the destruction of the aphis, Mr. P. D. Simmons, Mooi River, speaks to this effect: "I used a weak solution of tobacco water (nicotine), and also picked the leaves afterwards found with aphis on them. The spray pump I have fixes into a 56-gallon cask, and is mounted on a small cart. (*See Plate VIII.*) To it are connected two hoses. One boy pumps and another directs the hoses, holding one in each hand, and sprays as much under the leaves as possible. By this means I saved the whole of my crop, as aphis had appeared in quite a third of the roots and cabbages. They are clean, but should the aphis return I shall repeat the spraying. I consider this spraying, which cost but little, has saved me a hundred pounds."

THE WOOLLY APHIS.

Schizoneura lanigera, Hausman.

The woolly aphis is one of the most insidious pests of the apple tree all the world over, and is particularly destructive wherever apples are cultivated in Natal. As is the case of most of our troublesome pests, this, too, is an introduction from abroad, claiming, rightly or wrongly, America as its home. It is particularly harmful to apple trees of all ages, attacking both root and branch, and the mischief it will cause when following on the effects of a hailstorm is irremediable. Fortunately we may say of it that it is almost the only pest of the apple tree which we have locally to deal with, although so bad has its attack at times become that many have been discouraged from growing apples. I think it may be stated generally that it is whilst the trees are young that the greatest injury is done to them, but I have come across local instances in which certain varieties have resisted it for a number of years, and then been practically ruined by a sudden attack.

Woolly aphis takes its name from the mass of white, cottony threads secreted so as to completely mask the insect, which, when deprived of the covering, is seen to be of a brownish colour. The insect is often spoken of in the Old Colony as the "blood-louse," on account of the red stain it gives when crushed. Except in the months of March and April, only wingless aphides have been found in Natal, and in parts, during the winter months, the insects leave the trunk and limbs of the trees, and are found beneath the surface of the soil upon the roots. This is not always the case, of course, but I have in mind many instances where the aphis was plenti-

ful during the summer and not to be found on the limbs of the same trees during the later winter months.

Apple Twig infested with Woolly Aphis.

The pest is distributed on nursery stock and usually introduced to a farm upon young trees. It has not been noticed upon any tree other than the apple, although I have seen it upon quince in New South Wales.

Life History.

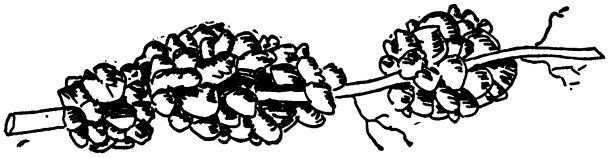
Like most colonies of aphides, those of the woolly aphis consist of agamic females, or stem-mothers, and they produce a succession of generations throughout the summer months. It is quite probable that in the higher lands of Natal, from the Mooi River and onwards, there is a close approximation to the habits of this insect in colder latitudes, though this does not hold good for other insects, the turnip aphis, for instance. The lice attach themselves to the tree by means of a long beak, through which they draw nourishment from the plant, and so affect its vigour and vitality. Wherever they attach themselves they cause abnormal swellings and distorted growths. As the tree is attacked both above and below ground, these swellings are found upon the roots as well as the branches, and are often found of quite a huge size about the collar of the tree. These growths are irregular and present many crevices in which the increasing colony of aphides find shelter. The insects are extremely partial to places where the bark has been bruised, and this accounts for their attack, when following upon the effects of a hailstorm, spelling the ruin, if not almost immediate death, of a tree.

Remedial and Preventive Measures.

On but a few farms is much done to control this pest, and though once in a while a few spasmodic attempts may be made to rid the trees, these are seldom followed up consistently. Of course, if a tree is very subject to woolly aphis, no single treatment will effectually free it of the pest for once and always and, unless it grows out of its susceptibility, as some trees are said to do here, a treatment once adopted must be continued.

Spraying with paraffin emulsion is confidently recommended, but this treatment should not be adopted unless one possesses a good spray pump. and, in the case of an orchard, this pump should be on a barrel and transported on wheels. The spray, too, must be directed with as much force as possible against the lice. Further, something must be done to lessen the number of insects upon the roots, from which source the branches will otherwise rapidly become infested. To do this some of the top soil must be removed and the roots drenched with hot water of 200 degrees Fahrenheit. Carbolic or nicotine sheep dip well diluted, might be used with equal advantage. One of the most

recent recommendations, however, is the application of tobacco dus This was most favourably reported upon by Professor J. B. Smitl of New Jersey, and its adoption is suggested to many of our appl growers, as it no difficult matter to obtain the tobacco dust, even they have to grow the leaves. For large trees it is recommende to scatter from 2 to 5 pounds of dust around the trunk after removin the surface soil. This treatment is said not only to cure the roc from blight, but also to prevent it being further infested.



Apple Root distorted by Woolly Aphis.

Passing from remedial measures which, on the whole, are n satisfactory under our existing conditions, we come to the question prevention. It has long been recognised that certain varieties apples do not suffer from the blight. We have an illustration of th in the "Old Dutch Apple" of the Colony which, if not altogeth blight-proof, is certainly blight-resistant. The immunity enjoyed l these blight-resistant trees has led to the grafting of sorts subject the blight on them, so that the trees have at least blight-proof roo which will not supply a fresh invasion of aphides for the trunk a limbs once they have been treated.

The difficulty in Natal is to obtain trees worked on to the bottoms, local nurserymen not being in a position to supply ma guaranteed stocks. They can, however, be obtained somewhat mc readily from Cape Colony, and the firm of Mr. H. E. V. Pickstoı of Groot Drakenstein, I believe, guarantee all they send out.

I have seen a party in Natal trying to obtain a large supply blight-proof stocks by planting cuttings from a tree and regrett that I was too late with my suggestion to "double work" the That is, to graft a piece of blight-proof root on to a piece of blig proof branch. By this means trees are obtained in quantity, on which any desired variety can be budded or grafted.

The following list of blight-proof stocks has been published the New South Wales fruit expert.

Sandringham.	Five Crown Pippin.
Wealthy.	King of Tomkin's County.
Kenyon's Red.	Duchess of Oldenburg.
Winter Permain.	Disharoon.
Winter Majetin.	Loddington.
Northern Spy.	Creasey's Seedling.

Willis' Late.

THE SCALE INSECTS.

Family *Coccidæ*.

The scale insects acquire their common name from the fact tl many species resemble small or rounded scales attached to the b leaves or fruit of plants. They belong to the same group of great bug-order as do the aphides, but the two sexes are very differ

from each other. The adult males are provided with a pair of wings, a pair of long antennæ and two large eyes. These males are, as a rule, very minute insects and very seldom observed; they have no mouth parts and, being incapable of taking nourishment, their lives are very short. The female scale insect is never winged and, as a general rule, remains fixed in the one spot throughtout her life. The females of many species are covered by a waxy, scale-like secretion, but in some families this is very often absent or considerably modified, as in the case of several species referred to later on. The female usually dies shortly after laying her eggs, and the matter she has secreted and her shrivelled body remain as a covering for these. The young which hatch from the eggs are minute six-legged creatures, which soon seek a convenient spot for inserting their proboscis or snout into the plant and commence pumping up the sap. They cast their skins several times during growth, those of the female sex gradually increasing in size without very marked changes. The growth of the male is quite different, for it may be said to go through a complete metamorphosis as, after a little while, it enters into a resting pupa stage, like a butterfly or moth, and ultimately emerges a winged insect. In this respect the *Coccidæ* present a distinct anomaly in comparison with the other groups constituting the order.

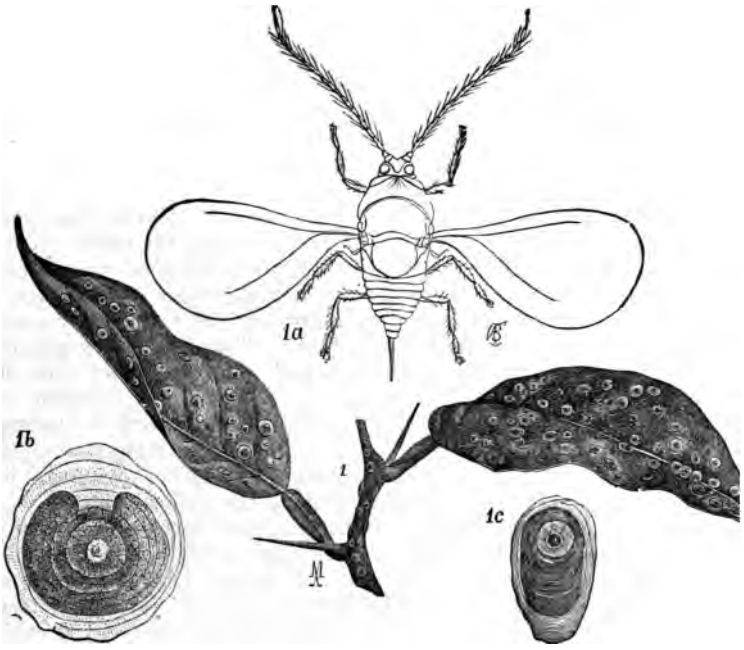
This group contributes to fruit culture a very large and destructive number of insect pests in all parts of the world, and new kinds are easily introduced into a country upon imported plants and trees, and it is from this source that Natal has received all its destructive kinds. Owing to their suctorial habits, they have to be treated with contact insecticides, or killed by poisonous gasses, hence spraying and fumigation are largely resorted to meet their attack and keep their numbers under control.

THE RED SCALE.

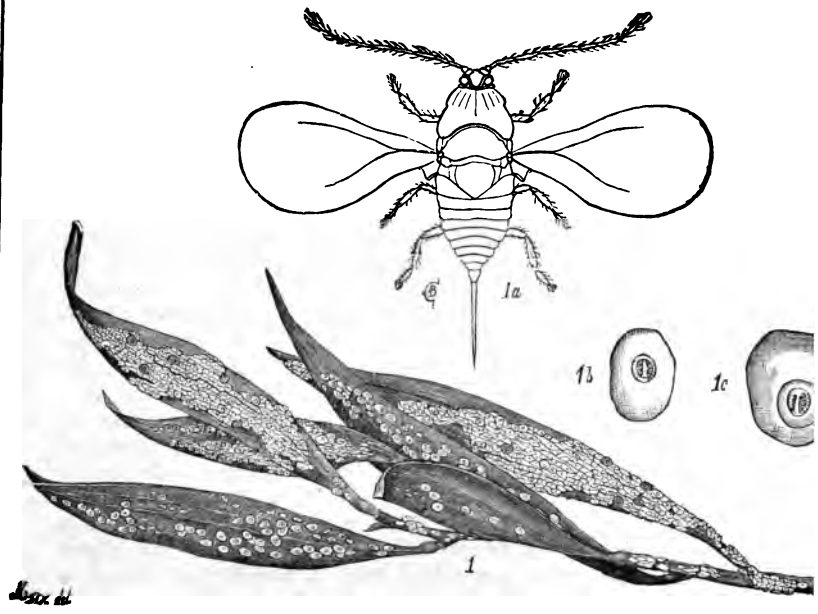
Aspidiotus aurantii, Mask.

Perhaps there is no scale-insect which does more general mischief throughout the world to citrus culture than this, so commonly referred to as the red scale. In Natal, so far as my observation goes, it seems more confined to the higher lands, 3,000 feet to 3,500 feet than above that and on the coast. At this elevation it is particularly destructive, and where trees are growing in poor soils and in unsuitable situations takes much fighting to keep it under control. Upon the coast I have but rarely seen it upon citrus trees, though it may flourish upon an occasional rose bush. What the mussel scale is, however, to the coast orchardist, the red scale is to his brother dwelling up country where the same causes, which have increased the virulence of the one upon the coast, have had the same effect upon the other. Indeed, it was no difficult matter to walk around Maritzburg during last July and pick out the trees succumbing to the combined attacks of this pest and the drought. There is, however, one consoling thought, and that is the apparently greater susceptibility of the red scale to the parasite fungus *Spaerobastibile coccophila*,* which in the wet summer makes much headway against the coccid. The red scale, unfortunately, flourishes upon a number of plants other than those of the citrus family. Certain roses suffer severely whilst a number of varieties never take it. Pears, apples and other fruits are also attacked, besides a besides a number of garden plants. (*See Plate XX.*)

* Determined by Prof. W. B. Galloway, U.S.A. Department of Agriculture.



The Red Scale.



The White Scale.

Description.

The eggs are seldom seen, as they hatch either within the female, or very shortly after being deposited.

The larvæ are extremely small, of a yellow colour, the eyes being dark.

The female is flattish and circular in outline, except at the posterior extremity, where it is deeply cleft.

The scale of female is of a reddish or red-brown appearance, due to the colour of the insect beneath and, when fresh, covered with a fine white meal or bloom. It is flat and about the size of a pin's head, being circular in outline, and with a nipple-like prominence in the centre, which is composed of the skin cast off by the larva. Like *Mytilaspis citricola*, there is, also, a ventral scale, but in this case it is more complete, so that the insect lies safely ensconced between the two.

The male is a minute fly with a yellow body and purple eyes.

The scale of the male is much smaller than that of the female and longer than wide, with the projecting nipple towards one end.

Treatment.

The red scale is, if anything, more difficult to deal with than others of this class, a circumstance largely due to the fact that it produces its young singly and in an active state, so that a whole batch cannot be killed off at once, and also because the female is so much enclosed by the scale. The most successful treatment is fumigation with hydrocyanic acid gas. This is generally very highly commended, and is by far the most effective measure. It, however, needs repetition and should be followed by spraying with resin wash or paraffin emulsion. One may say of it that it kills off nearly every scale, but some few escaping form the nucleus of a fresh invasion. If spraying be adopted soon after fumigation it will meet with a great amount of success, and prove encouraging, for this is a pest we cannot hope to bring under control by a single treatment.

THE CIRCULAR PURPLE SCALE.

Aspidiotus ficus, Riley.

This is a pest found in many orchards in the coast belt, to which it appears to be confined. It is not, as yet, so general as the mussel scale, but shows great potency as a mischief-maker, and is a pest to the suppression of which citrus growers must look. As is also the case with many of the scale insects mentioned in this report, this is introduced from abroad, and in America is referred to as the Florida Red Scale, though why it should be termed red it is difficult to discover. It attacks several garden plants and has evidently been largely distributed upon nursery stock.

Description.

The eggs are yellow.

The larvæ are active, yellow and small, with oval bodies and dark eyes.

The female is usually light in colour, but sometimes dark, somewhat pear-shaped, the last segment being yellow.

The scale of female is circular and usually one-twelfth of an inch in diameter, of a deep purple or black colour, with a central red boss or nipple-like projection. Unlike the scales of *Aspidiotus auranti*, there is no ventral scale, and the female and eggs are at once exposed to view when the scale is overturned with a pin or the point of a knife. The male resembles that of *A. aurantii*, being small and yellowish.

The scale of the male is almost circular, and about ¼ the size of the female scale.

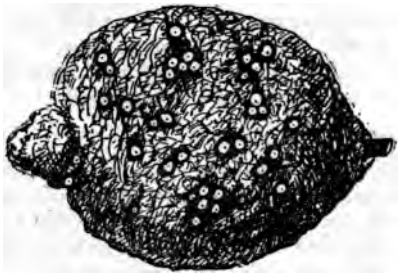
Treatment.

Fumigation or spraying with resin wash or paraffin emulsion.

THE WHITE SCALE.

Aspidiotus nerii, Bouché.

This pest is usually referred to as the Oleander Scale, owing to its presence upon that plant in other countries. Though the oleander grows commonly in Natal under the name of the Ceylon rose, I have not up to the present observed the pest upon it. Neither is it by any means of common occurrence, and, were it not for occasional fruits—mostly common lemons—seen infested with the scale upon the local market, I fear I should have overlooked it. To what circumstance its present rarity is due I cannot say, but one may hope that the climate is unsuited to it. (*See Plate XX.*)



White Scale on Lemon.

Description.

The eggs are light yellow.

The larvæ small, oval, yellow and active.

The female is nearly circular in outline, somewhat pear-shaped, and of a light yellow colour.

The scale of the female is circular in outline and flat. The central part is yellow, surrounded by a wide ring of white or grey secretion, about one-twelfth of an inch in diameter.

The scale of the male is longer than wide, and white, with a bright yellow boss formed by the cast skin of the larva.

Treatment.

Spraying with paraffin emulsion or resin wash.

THE GREEDY SCALE.

Aspidiotus camelliæ, Sign.

This insect is popularly known as the "greedy" scale on accoun of the number and variety of plants it attacks. In Natal it is not particularly common, but has been found on several occasions infesting pears and acacias, and once upon a native plant in the vicinity of an orchard. I would not care to say on this evidence that it is a species

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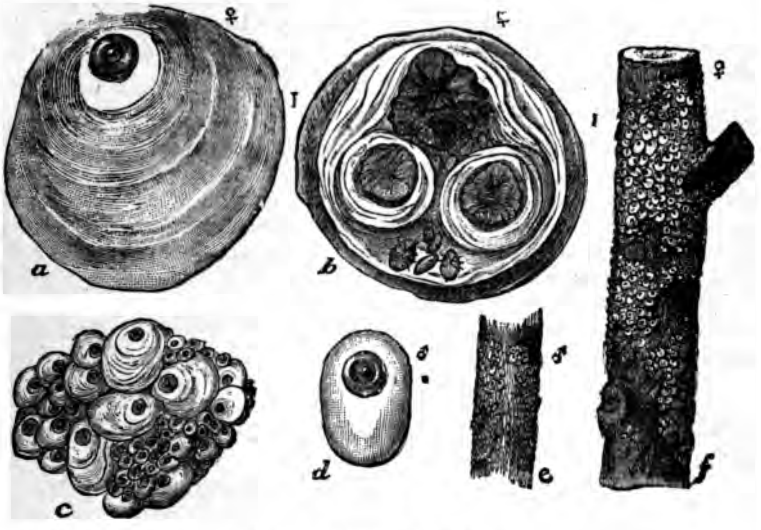
Explanation of Plate XX.—The Red Scale (*Aspidiotus aurantii*, Mask). 1. scales on leaves of orange, natural size; 1*a*, adult male, greatly enlarged; 1*b*, scale of female, enlarged; 1*c*, scale of male, enlarged. (From U.S.A. Department of Agriculture. Block loaned by C. P. Lounsbury).

The White Scale (*Aspidiotus nerii*, Bouché). 1, scales on leaves of acacia, natural size; 1*a*, adult male, greatly enlarged; 1*b*, scale of male, enlarged; 1*c*, scale of female, enlarged. (From U.S.A. Department of Agriculture. Block loaned by C. P. Lounsbury).



The Greedy Scale.

The White Peach Scale.

which will not thrive here; but believe that very little of it has, a yet, been introduced into the Colony. It is supposed to have com originally from America, Australia and elsewhere. With regard t the plants which it is known to attack, the list is a fairly long on including many ornamental trees. Among others it has been take upon the following important plants: Pear, apple, guava, fig, loqua walnut, olive and tea plant. (*See Plate XXI.*)

Description.

The scale of female is generally of a dirty grey colour when at a old, and white or yellowish when fresh. It is almost circular an convex, with a greenish or grey nipple to one side of the centre; th is composed of the cast skin of the larva. Scales one-twelfth to on fifteenth of an inch in diameter. The scale of the male is smaller tha that of the female, and longer than wide.

The female insect is of a yellowish colour, and lies beneath th scale described above upon a thin white scale which keeps its boc from direct contact with the surface of the bark.

Treatment.

This pest yields readily to sprayings with paraffin emulsion or res wash.

THE WHITE PEACH SCALE.

Diaspis amygdali, Tyron.

The white peach scale was first described by Mr. Tryon fro specimens found in Queensland, but it is supposed to have original come from Japan, and is now found very widely distributed. It a very common pest of the peach in the Old Colony, though at pr sent not generally distributed throughout Natal. I have met with on one occasion at Balgowan and frequently in Maritzburg. Greytown, however, it is very plentiful. Its favourite host-plan are the peach, mulberry and passion fruit, and it is also partial plums and the white cedar *Melia Azedarach*. It exists, however, up numerous other plants, among which may be mentioned the Cape goo berry, grape and geranium. (*See Plate XXI.*)

Description.

The scale of the female is circular and white, with a yellow bc or nipple to one side of the centre. It measures about one-twelfth an inch in diameter. The male scale is of a different nature, bei pure white, and one-sixteenth of an inch in length, and very narro These scales are often so thickly massed together that affected twi appear clothed in some snow-white material.

Treatment.

The most successful treatment for this pest is a winter sprayi with lime salt sulphur mixture. Summer treatment consists of spra ing with paraffin emulsion or resin wash.

Explanation of Plate XXI.—The Greedy Scale (*Aspidiotus camelliæ*, Sign *a*, female scale from above; *b*, same from beneath; *c*, mass of scales as appearing bark; *d*, male scale; *e*, male scales on twig; *f*, female scales on twig; *e* and natural size; *c*, much enlarged; *a*, *b*, and *d*, greatly enlarged. (From U.S Departmcnt of Agriculture. Block loaned by C. P. Lounsbury).

The White Peach Scale (*Diapsis amygdali*, Tryon). *a*. male and female sca on bark; *b*, female scale, enlarged; *c*, male scale, enlarged; *d*, group of male scal enlarged. (From U.S.A. Department of Agriculture. Block loaned by C. Lounsbury).

THE MUSSEL SCALE.

Mytilaspis citricola, Pack.

This scale insect is possibly a native of Southern Europe and is chief among the insect pests of the orange and mandarin upon the coast up to an elevation of 2,500 feet. It is capable of great reproduction, particularly in seasons of drought, and when trees are neglected at such times, it often ruins them utterly. Of this there was ample evidence during 1889 and 1900. Found on Citrus plants only. *See Plate XXII.*)

Description.

The scale of the female is mussel-shaped, often curved, and about one-tenth of an inch in length. Usually covered with very fine waxy meal, and of a purplish colour when fresh, but brown when old. The anterior end is narrow and pointed, the posterior broad and rounded.

Attached to the narrow end may be seen the two cast skins thrown off by the insect in the course of growth. Upon turning over the skin with a pin point, a flat, white, ventral scale will be noticed, and between this and the upper scale lies the female and her eggs.

The female is a pale white elongate grub, and is generally found in the narrow end of the scale with her eggs.

The eggs are small, white and oval, and lie behind the female in the broader end of the scale.

The scale of the male, from which it emerges after pupation, is of a dark brown colour, somewhat resembling the scale of the female, but straighter. The narrow end is finished off with the cast skin of the larval stage, and the posterior end is hinged to allow the adult to emerge, which it does by backing out tail first. The adult male is a minute two-winged fly.

Treatment.

Spraying with paraffin emulsion or with resin wash has been found in practice the best treatment for the pest. The spraying will, however, have to be done regularly. Fumigation of badly infested trees does them a great deal of good, but its effect is only temporary, as all the eggs are not killed, and the treatment must soon be repeated or else followed up with sprayings.

SOFT SCALE.

Lecanium hesperidum, Linn.

This insect is occasionally met with upon citrus trees, both on the coast and the midlands, but it can scarcely be claimed as a very destructive pest, although I have an orchard in mind where it is very prevalent. The chief drawback of the soft scale is the unsightly appearance it gives to the trees it affects, through the growth of a black fungus known as "sooty mould" or "fumagine," which often covers the upper surfaces of the leaves and fruit. This sooty mould in itself is not a parasite upon the tree and derives no nourishment therefrom, but subsits upon a sweet fluid produced by the insects. This fluid is commonly known as honey-dew and the presence of large numbers of ants upon affected trees is also due to it, the ants seeking the honey-dew as food. In this connection it is interesting to note that we have

in Natal an ant, well known to every farmer, which builds nests in the form of a large ball in the limbs of native bushes. This ant is very fond of honey-dew, and many times have I found it seeking this delicacy among colonies of scale insects in the wild bushes, and I have noticed that, in the case of a scale insect, closely allied to the soft scale and much subject to parasites, that the ant will cover them carefully with domes composed of triturated matter, leaving but one small entrance for themselves. These remarks will, I hope, meet and explode the common opinion that black ants eat and destroy scale insects. (*See Plate XXII.*)

DESCRIPTION.

This scale insect differs considerably from those previously discussed, and belongs to a group which does not cover itself by secreting a shield, the only protection being a certain hardening of the dorsum or back. The full-grown female is about one-twelfth of an inch in length, wide and oval in outline, with the back raised and smoothly convex. The sides of the body are flattened and cling to the surface of the leaf or twig. It is of a brownish colour and faintly mottled. The species is distinct from certain others, inasmuch as the young are brought forth alive. These are active, of a light yellowish colour and oval in outline. The male insect has never been discovered.

THE AUSTRALIAN BUG.

Icerya purchasi, Mask.

The Australian bug is found in most parts of Natal, both upon the coast and throughout the highlands, but scarcely, if ever, in large colonies. It may occasionally be seen upon an odd acacia, and sometimes in a small colony upon citrus plants, but it is more general upon rose bushes. Its attack is seldom severe enough to call for serious attention and can generally be met by handpicking, or by cutting out the twigs bearing the bugs and burning them. The story of the Australian bug is a long and oft-repeated one; let it suffice here to say that it is common upon native plants in Australia, but has never been guilty of any considerable damage in that country. Years ago, however, it was carried about throughout the world, and the orangeries of California and the Cape suffered particularly from its ravages until its natural check, a predacious lady-bird, generally known as the Vedalia, was found in Australia by an American naturalist who had gone there to search for native checks through the hopes of finding such held out by Fraser R. Crawford, of Adelaide, S.A., the father of Australian economic entomology. The success of the Vedalia ladybird (*Novius cardinalis*) as a natural check is one of the crowning efforts of applied entomology. and needs no-retelling here. It may, however, be added, that as a matter of personal observation I myself have found the native insect *Rodolia icerya* of Jansen

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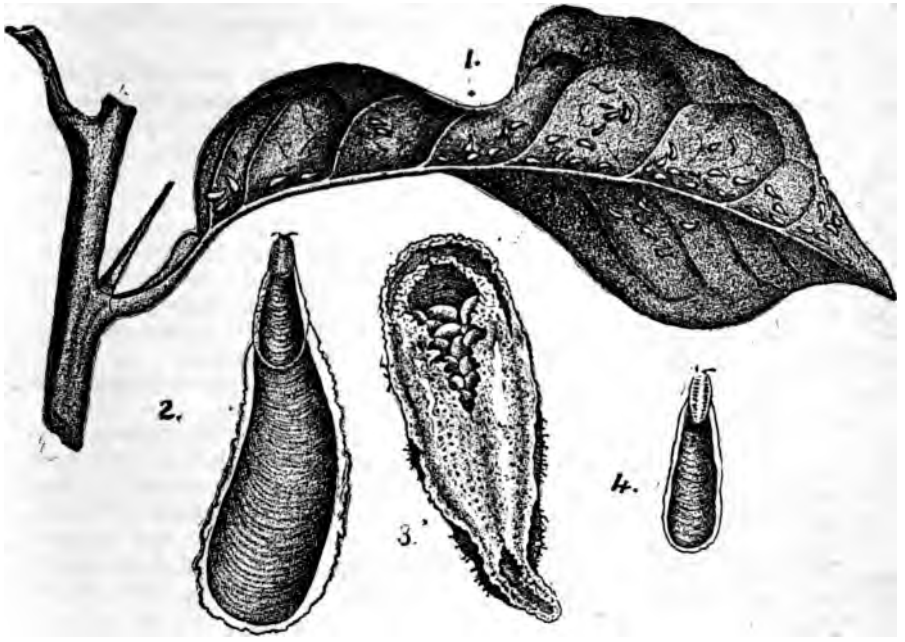
Explanation of Plate XXII.—Orange Mussel Scale (*Mytilaspis citricola*, Pack.) 1, scales on leaf of orange; 2, scale of female from above; 3, scale of female from below; 4, scale of male; 1, natural size, others much enlarged. (Copied from U.S.A. Department of Agriculture. Block loaned by C. P. Lounsbury).

The Soft Scale, (*Lecanium hesperidum*, Linn.). Adult females on orange, natural size. (From U.S.A. Department of Agriculture. Block loaned by C. P. Lounsbury).



Mussel Scale of Orange.

Soft Scale.

always earlier on the field and doing better work in Natal than the Vedalia, which, curiously enough, manifests as great a partiality for the young Rodolia as for the bug.

The Australian bug rejoices in several other appellations, and is here commonly referred to as Dorthesia. This is, however, a misnomer. In America it is referred to as the "Cottony Cushion Scale," or the "Fluted Scale." (*See Plate XXIII., fig. 10*).

Description.

The Australian bug is considerably larger than any of the scale insects which have been referred to already, and the best-known form is that of the adult female with her large white egg-sac attached.

The eggs are, as usual, small, but of a bright red colour, and may be found by the hundred in the white sac of the female.

The larvæ are small and red, the legs and antennæ being of a dark brown colour.

The adult female is of a dark orange or brownish colour, with black legs and antennæ. The back is covered with white or yellowish meal, and the margins are usually fringed with a number of fine silken threads, measuring a quarter of an inch in length. Female and sac together measure about half an inch. The sac projects behind the female. It is longer than wide; white, very much raised and rounded and characterised by corrugations running from end to end.

The male is reddish in colour, with smoky coloured wings. It is about one-eighth of an inch in length, and so considerably larger than those of the other species affecting citrus plants; like them, however, it is seldom noticed except by the practised observer.

Treatment.

I have already said that, so far as Natal is concerned, in the majority of cases setting a kafir to remove the bugs once in a while will prove the most satisfactory course to pursue. It may, however, be added that spraying will not generally meet with very encouraging results, although many bugs may thus be destroyed. In a bad case the best plan is to obtain some beetles to prey upon them, but this is not altogether an easy matter. During the last year I have been able to supply several parties with colonies of Rodolia or Vedalia, but this is not always possible. In Cape Colony a regular trade is done by the Agricultural Department in Vedalia; colonies of ladybirds being sold at 10s. each. Several Natal farmers have already benefited by this system, which the Cape department is able to carry out because of the favourable conditions existing at the Peninsula. I can, however, state from personal experience that the obtaining of these colonies is attended with much tedious labour, and trust that no applications will be sent from this Colony to the Cape.

THE ARAUCARIA MEALY BUG.

Dactylopius aurilantius, Mask.

The Araucaria mealy bug is one of the most destructive pests found upon these handsome pines. The species was first brought to my attention by the Rev. J. R. Ward, of Richmond, who had found it in his garden upon the Norfolk Island pine, *Araucaria excelsa*. Sub-

sequently I found it in Maritzburg on the Bunya Bunya (*Araucaria Bidwellii*) and again on *A. braziliensis* in the Town Bush Valley. It also occurs in Durban on both *A. excelsa* and *A. Bidwellii*, and has undoubtedly been introduced from Australia upon these plants. This bug does not appear to suffer to any extent from parasites, and the only insect I have found preying upon it is the small black ladybird with yellow cheeks (*Exochomus nigromaculatus*), but this is never sufficiently abundant to make any beneficial impression. At first sight the female mealy bug does not appear to have much in common with the usual form of this group, as its body is black and lacks the characteristic coating of white mealy wax. In place of the white meal, however, it has a number of bright, yellow-coloured tufts of wax arranged so ornamentally as to make the insects, when viewed individually, rather pretty. A ridge of these tufts runs from end to end of the body along the middle of the back, and a similar fringe adorns the margin of the body.

The eggs are of a purple colour and laid in a tangle of wax threads secreted by the female. The young, when they hatch, are inconspicuous and at first dark purple to black in colour. Subsequently, when they begin to feed and secrete their tufts of golden wax, they are more easily noticed. The male insect is the usual two-winged fly, and emerges from small cocoons always to be found hidden beneath the broken bark-scales of the tree trunk, far apart from the females; and it appears that the young male larvæ early migrate from the leaves and branches and derive their nourishment from the trunk.

The Araucaria Mealy Bug.

Treatment.

This is an extremely difficult pest to deal with in the case of a large tree, and I doubt whether it is worth while, in most instances,

trying to combat it. A better plan, if it is desired to save the tree, would be to manure it well; giving it a liberal supply of water through the dry winter months and so invigorate it sufficiently to withstand the effect of the insect. On smaller trees, several sprayings with paraffin emulsion or resin wash will do much to keep in check. The most important point, however, to consider is, in purchasing Araucarias, to make certain that they are free from this coccid. It is not difficult for the nurseryman to supply clean trees, and whilst they are still small, care and several well-timed fumigations, will keep them quite free from scale insects.

THE NORFOLK ISLAND PINE COCCUS.

Eriococcus araucariæ, Mask.

This insect is well known in parts of Natal, and also in Cape Colony, as a pest of the several Araucarias. It also occurs in North America, Australia and New Zealand, where it was first discovered and described by the late W. M. Maskell. Early in its attack the affected trees become unsightly, owing to a sooty black mould which spreads over the leaves and branches. The presence of this is entirly due to the scale insect, for, like many other coccids, this exudes a sweet, watery secretion known as honey-dew, which, falling upon

The Norfolk Island Pine Coccus.

the leaves and twigs forms a medium or nidus in which the fungus, known as fumagine, flourishes. It is generally claimed that this fungus growth, being purely superficial, does no material damage to the plant. Nevertheless, on account of its even distribution and the large quantity of it usually present, it seems to me reasonable to infer that it does interfere with the functions of the leaves to some extent. the effect of the scale upon ill-nourished trees is soon noticed, but vigorous plants in good soil, though often rendered unsightly, do not appear to suffer greatly. This scale insect, in inhabiting for part of its life a peculiar envelope, in which the eggs are ultimately deposited, differs from those with which farmers are more familiar. It

is perhaps best described by drawing attention to the accompanying illustration, which shows an infected twig of *Araucaria excelsa*. Upon the twig are depicted a number of white cocoons. These envelop the full-grown females, and are usually known as sacs. They are formed of cottony threads secreted through the epidermis, which have become closely matted and interwoven into a thin felt. If an infested twig, similar to that figured, is examined, four or five stages of the insect's natural history may be discovered. First we notice a number of white, oval cocoons, formed of cottony threads which have become closely matted and interwoven. This felt-like envelope is secreted through pores in the epidermis of the insect, and is usually spoken of as the sac. If one be examined, the adult female or her eggs may be found within it. Should the eggs be discovered, the dead and shrivelled body of the female from which the eggs have been expelled may also be found. Attention will be arrested by a series of smaller cocoons; these are the cocoons in which the males have matured and from them emerged as two winged flies. Amongst the cocoons there will be seen numerous yellow specks, stationary or moving about; these are the young or larvæ. Larger yellow insects, females which have as yet not formed their cocoons, will also be noticed.

Treatment.

The same remarks apply to this insect as I have made in speaking of the Araucaria mealy bug.

OTHER SCALE INSECTS.

There are several other kinds of scale insects found in Natal which, for the present, may be dealt with in a few general remarks. Six, at least, are confined to the coast, and not generally found more than twenty or thirty miles inland. These are the pine-apple scale (*Aulacaspis bromoliæ*, Kerner.), the pine-apple Dactylopius (?*D. bromelia*, Sign.), the wax insect of the custard apple (*Ceroplastes*, sp.), an *Aulacaspis* rarely seen upon bananas, a *Chionaspis* common upon mangoes, and *Orthezia insignis*, the handsome coccid which occurs so commonly upon Lantana scrub and does so much mischief to Coleus and other ornamental plants. Mention might also be made of *Asterolecanium bambusæ*, which abounds upon the different bamboos; a rare *Diaspis* occurring upon sugar cane, and the common sugar cane mealy bug, *Dactylopius*, sp.

The Pineapple Scale occurs commonly where these plants are grown and has, without doubt, been introduced at various times on suckers from abroad. The female insect rests beneath a small white, circular scale, somewhat flat, with a yellow spot at one side, and through which the insect can usually be seen. The scale under which the male lives, during the earlier stages of its existence, is much smaller than that of the female. It is long and narrow, having the sides parallel, and being marked with three parallel ridges. The insect is capable of doing considerable damage to the leaves, if neglected, and I have seen dead areas in pineapple fields which have been killed off by it. The leaves suffer more severely when the insects are massed in one spot, than when scattered. When they are massed together, the attacked area turns black and rots, and in this manner the leaves of a plant are often all killed off. The simplest treatment for this pest is spraying. The best preventative, to plant only clean

suckers. But if, perforce, scaley suckers must be planted, then they should be either fumigated, or dipped in paraffin emulsion beforehand so as to destroy the insects.

THE PINEAPPLE MEALY BUG.—This insect has a general resemblance to many other mealy bugs, being of a somewhat pinkish colour, covered with a fine coating of white meal, and ornamented around the margins of the body with a fringe of white, waxy tassels. I cannot say that as yet I have come across much injury done by it, although in the Cape Colony it is regarded more seriously. Without doubt, however, it weakens the growth of the plants, and similar care in planting out suckers as advised in the case of the above scale insect should be taken. Considering the comparative freedom from the pest, the following excerpt from a Grahamstown journal makes charming reading:—

"We are glad to notice that the disease in pines, to which we drew attention some time since, has been the subject of a resolution of the Bathurst Divisional Council, which body at its meeting on the 9th inst. resolved to memorialise the Government on the subject, asking that infected pines may be destroyed, and compensation given, also that the cultivation of pines in such infected spots may be prevented for at least a year. We trust that Government will speedily act in this matter, as the disease threatens the destruction of a most important and paying industry. It appears that through the neglect of the Natal Government, that Colony has become thoroughly infected with the new plague, which came in, we are told, with the new sorts of pines imported a few years ago. East London is also infected, and no doubt the pine-growers of that district will gladly act with us."

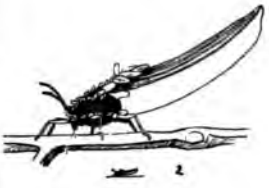
CUSTARD APPLE WAX INSECT.—This belongs to a group best known to Natalians as supplying the material with which the kafirs make their head-rings. They are difficult insects to deal with, so far as spraying and other methods are concerned, on account of their thick coating of wax. In this case the insects seldom have time to assume destructive proportions, thanks to the larvæ of a small moth (*Thalpocares*, sp.), which prey upon the scale, and soon demolish it.

ORTHEZIA INSIGNIS.—Other than as a greenhouse and garden pest this does not call for much attention, although under certain circumstances it is capable of doing a good deal of mischief. Unlike many other scale insects, the females move about during the whole of their existence, and in the adult stage carry the eggs in an ovi-sac of waxy material attached to the posterior end of the body. This sac, which is long and narrow, with parallel sides, is also rather handsomely marked with parallel carinations. The younger females and the larvæ are flattish, oval creatures, of a dark brown colour, and ornamented with white plates of a waxy matter. These occur upon the back and sides; those upon the back are narrow and arranged in two rows, whilst those upon the sides are much broader and more conspicuous, one plate being attached to either side of each division of the body. The adult female measures about one-sixteenth of an inch in length of body, but with the egg-sac, which it now bears in addition to the body plates, gives it the appearance of being four or five times that length. The young are hatched in the sac referred to and make their exit through a more or less square opening in the posterior end. Having acquired their freedom, they seek the leaves and stems of the plant and start feeding early in life. Often the best treatment for this pest in cases of infested plants, is to destroy plant and all. (*See Plate XXIII., figs. 1-5*).

PLATE XXIII.

1.

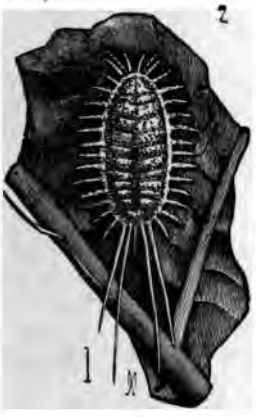
2.



3.

4.

5.



6.

7.

10.

8.

9.

* Sugar Cane Mealy Bug.—This insect is a typical mealy bug, well known to every cane-planter upon the coast. Huge colo of it are often to be found beneath the leaf-sheaths, but they s to do little appreciable damage and remedial treatment is out of question. If, however, cleaned cuttings are planted, very little of pest occurs in a cane field.

Explanation af Plate XXIII.—Ortlexia insignis. Fig. 1, twig of infected Col fig. 2, adult female, top view, enlarged; fig. 3, adult female, side view, enlar fig. 4, immature female, enlarged; fig. 5, adult male, enlarged.

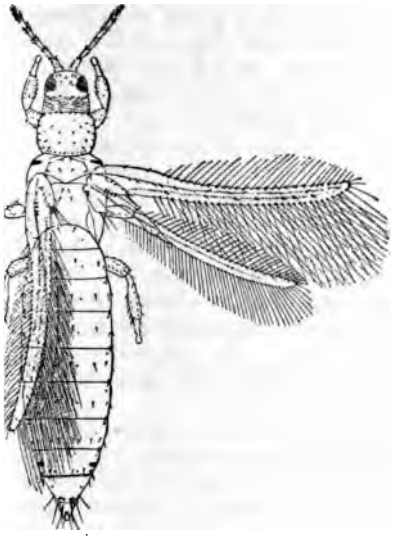
Mealy Bugs. Figs. 6, 7, 8, and 9; 6, 7, and 8 enlarged; 9 natural size.

Australian Bug. Fig. 10 showing adult females massed on twig. (Figs. 6 7 from U.S.A. Department of Agriculture.)

THRIPS.

ONION THRIPS.

Blighted onion plants have upon several occasions been sub-ed for examination. Complaints were made that the plants red severely from this form of blight, which could be recognised ne sickly and whitish appearance of the tops. Upon examination the plants were found infested with numerous minute insects, known as thrips, which can only be recognised by the unaided eye as minute travelling yellow specks. White blast of onions, as this form of attack has been designated, is known to exist in many parts of the world, and the species known as *Thrips tabaci* is the one generally recognised as the mischief-maker. Probably the one we have here, which no doubt thrives upon a number of plants, is the same. The thrips constitute a natural order known as *Physopoda*. They are all extremely minute, varying, as a rule, from one-fiftieth to one-twentyfourth of an inch in length. There is, however, one species known in ralia which is quite a giant, measuring no less than one-third of ch in length. In their early stages thrips are wingless, and are minute, creeping things, possessing powers of jumping or flicking selves rapidly from one spot to another. When they are adult are supplied with two pairs of wings, which are remarkable for slenderness, and for the complete fringe surrounding each. ps are treated after the same manner as aphides, and an applica- of paraffin emulsion would probably yield excellent results.



A Thrip, enlarged (after Fernald).

THE ROSE THRIPS.

This is a smaller species than that found upon onions, and in the g of the year is responsible for the destruction of a number of ms. There is no remedial treatment more effective than the ering and destruction of all attacked flowers.

TICKS.

Quite a large number of the most interesting ticks described from South Africa were originally sent from Port Natal, and undoubtedly in those comparatively recent days, when big game of all descriptions roamed over the country, a far greater variety of these parasites must have existed than now that none remain. The variety of ticks found in any abundance, at present, is not really so great as is usually supposed, and this is due to the fact that not only are the males and females of the one species looked upon as different kinds, but so also are the ticks in the earlier stages of growth, when, as a rule, they differ considerably from the adult forms.

Ticks, as I have already had occasion to point out, are not, strictly speaking, insects. They are near relations, however, and in many ways resemble them. Young ticks are always hatched from eggs; like insects, also, they grow in much the same manner, except that their teguments are more elastic, and consequently there is not so great a necessity for such frequent casting of the skin. There are three well-defined periods from the egg, the first being the larva, the second the nymph, which corresponds with the pupa of a true insect, and the third the adult stage, or imago. In the adult stage ticks are provided with eight legs, and the sexes differ considerably from one another.

Upon first entering the adult stage there is little difference in point of size between the sexes, but this state of affairs soon changes, for, while the male never increases much in size, the female engorges herself with so much blood that she distends to several times her original size. This blood is rapidly digested and assimilated, and goes to the formation of huge numbers of eggs. These are subsequently deposited in some crevice or secluded spot in the soil, which the female has sought after falling from the host, when filled to repletion. The life of the male upon the host is usually spent in company with a female, and it is not uncommon for one to have several changes of affection during a lifetime.

The young ticks which emerge from the eggs are small, six-legged creatures, whose bodies are seldom as large as the head of an average-sized pin. Upon hatching they at once seek some point of vantage and there they bask in the sunshine, be it upon a grass top, a veld bush or a fencing post. And, crowded and resting patiently together, they await, during the daytime, for weeks and even months, the passing of a host. As a considerable period may elapse before this happens, Nature has endowed them with a tenacity of life which is truly remarkable. No growth takes place while they starve, and they remain alive and ever on the alert. Some have actually been kept in stoppered bottles by Mr. Lounsbury in Capetown for seven months and in Maritzburg I have myself had them alive in glass-stoppered phials for four and five months at a stretch. This extraordinary faculty is also shared to some extent by ticks in the later stages of life.

After having gained access to a suitable host, the young tick attaches itself and, growing rapidly, soon is ready to cast its skin and become a nymph. For this purpose most species leave the host, but some—the common blue tick to particularise—do not. Having completed the transformation, the nymph again seeks a host and

feeds to repletion once more. Then the second moult occurs, and the tick is now mature and the sexes differentiated.

The construction of the rostrum or mouth parts of ticks, is interesting, and attention may be drawn to several of the features. First to be mentioned is the barb or labium. This is a broad, flattened organ, the lower side of which is furnished with numerous hooks directed backwards so that, when embedded in the flesh, it cannot be forcibly withdrawn with ease. Above this lie a pair of rod-like organs, which bear upon their ends the biting hooks or mandibles. These latter organs are no doubt used for piercing the flesh and making an entrance for the barb. Upon each side of the rostrum is an organ known as the palpus, which is often grooved upon the inner margin and applied closely to the proboscis; it is, however, articulated and movable. These parts constitute the head, which fits into a circular opening in the body, spoken of as the "neck ring."

The sexual orifices of the two sexes are situated upon the under side of the body, close below the neck, and in copulation certain species are supposed to bring these into apposition. At least three species have been noticed in which the proboscis of the male is buried in the vagina of the female, but whether there is actual copulation has not been ascertained. The original observation of this habit is due to E. G. Wheler, Alwick, England. It has also been noticed in a second species by Lounsbury in the Cape and in a third by myself in Natal.

In depositing the eggs the vagina is extruded considerably and the egg born upon the apex. When this action takes place the proboscis is withdrawn almost entirely within the neck ring, and the vagina, being directed forward, the egg comes within reach of the palpi, which hold it, whilst two glands are thrust out from the back of the neck. These glands cover the egg, presumably, with some hardening fluid, and it is then conveyed on until it rests upon the back of the female. The number of eggs laid by a single female tick varies with the species from ten to twenty thousand.

The Treatment of Ticks.

Ticks, particularly distended females, are very susceptible to contact insecticides and are easily killed by many of these. The difficulty, however, consists in killing all the ticks on a beast without in any manner injuring it, and in preventing reinfestation.

With regard to the use of washes, I think it can safely be said that their effectiveness depends to a very large extent upon the thoroughness and the persistency with which they are applied, more than upon anything else. The real difficulty in contending with ticks is found in preventing re-infestation, and this is no easy matter to undertake. Judicious burning off undoubtedly has a great influence upon the number of ticks with which a farm is infested, and it is equally true that the practice of burning the veld throughout the Colony tends, in a great measure, to prevent these parasites from becoming the scourge which they otherwise would be. Still, ticks are troublesome enough, and the ridding of them from farms is a task most farmers cannot contemplate. Still I know of instances where, by the persistent application of washes to the herd, their increase is largely checked.

The manner of applying tick washes depends upon the amount of work to be done and, where that is large, dipping or immersing the animal bodily, is the most favoured method. In North America

and Australia "dips" have been largely used for destroying ticks. For cattle it is, of course, necessary to have a large vat, and this is filled with water and the insecticide poured upon the top of that. Many oils have been used for this purpose, and the most satisfactory results have been reported from the use of cotton-seed oil.

Insecticides for the destruction of ticks have also been successfully administered with spray pumps. It is in this manner that a farmer in Cape Colony tackles the ticks upon his farm. A crush pen with a narrow run is arranged, and once in this the beast can be easily treated from either side. For this purpose, I understand that pure paraffin has been used with much success. This oil, of course, has a tendency to burn, but if the beast is allowed to dry rapidly in the sun the oil has no ill effects. Many of the patent sheep dips are also largely used, and with their application most farmers are already familiar. Upon the coast I have found many owners of cattle using a solution of arsenic as a dressing for ticks. This is prepared somewhat similarly to locust poison, and the following formula for its preparation has been supplied to me by one who uses it largely and with much success.

TICK WASH.

Soft Soap	5lbs.
Washing Soda	8oz.
Arsenic	4oz.
Water	3 galls.

These ingredients are placed in a paraffin tin and boiled together for 15 minutes. The mixture may be bottled off and on cooling will form into a jelly. This will keep indefinitely, and for use is diluted in the proportion of one bottle of mixture to seven of water. It is applied with a brush, and rubbed well into the more affected parts.

THE TORTOISE-SHELL TICK.

Amblyomma hebræum, Koch.

This is the "Bont Tick" of Cape Colony, so named because the word "bont" has the same meaning as the English word "variegated." The Dutch name is not, however, retained here, as but few people know the tick by that term. The species is found along the coast-belt of the Colony, and, except upon trek cattle, never, I believe, far inland. From inquiries made, it is not common to the country lying between Maritzburg and the "berg." The name of the tick is derived from the handsome colouring of the male, which sex is more generally known than the female. The female is perhaps one of the largest of our cattle ticks, but despite its size it is not so striking a creature as the smaller male. It has not been my good fortune to take more than passing notice of the natural histories of ticks since coming to Natal. In Cape Colony, however, I have reminiscences of studies of these in conjunction with Mr. Lounsbury, which were broken off, upon my part, to come to Natal. They have, however, been most thoroughly and patiently continued by my then chief, who has published some account of his observations, particularly in connection with the species under discussion. These observations being so interesting and reliable I take the liberty of reproducing them here for the benefit of those who are interested in the subject, and I trust that the author will not object to my alteration of his designation "Bont Tick" into that of the Tortoise Shell Tick.

Its Life History and Habits.

"The Tortoise-shell tick* is so called because of the mixed colouring of the male, "bont" in Dutch being about equivalent to the English word "variegated."

The male is a handsome creature. A typical specimen is broadly ovate—that is, egg-shaped in outline, broadest behind, a fifth of an inch in length, and almost flat. Occasional individuals a full quarter of an inch in length are found and, now and then, diminutive specimens less than one-sixth inch. The shape, too, varies, and some individuals are almost circular. The back of the male is entirely covered by the so-called "shield." This is firm to the touch, exceedingly tough, and is resplendent with bright, glistening colours. The prevailing tint is slaty grey. and is broken into patches by irregular black lines edged with green and a tinge of gold. The whole effect is that of hieroglyphic characters inscribed on a pearly shell. The legs are dark brown with paler bands at the joints. The mouth organ or "rostrum" is a third as long as the body, and one has but to view its wonderful arrangement of cruel hooks and knobbed piercing organ under the microscope to understand how the tick attaches itself so firmly to the skin of its host that attempts to remove it generally result in tearing away a piece of flesh or in breaking the tick. The male does not perceptibly increase in size when once it is adult, nor gorge itself with blood.

"The female varies from almost dead black through green to chestnut brown in colour at the time it gets on to an animal as an adult. The front part of its back only is occupied by the shield, and to this portion is restricted the gay markings of gold, green and black which at once serve to identify it with its mate. The female gorges herself with blood, and as she enlarges becomes distinctly reddish-brown with a band of red around the hinder margin. When fully distended she may measure all of an inch in length, three-fourths in width, and half in thickness; small specimens may not attain much over half these dimensions.

Hosts and Habits.

"The Tortoise-shell tick attacks all kinds of stock farmed in Cape Colony. and is not at all adverse to fastening on to human beings, black as well as white. Ostriches become affected, and if it were not for their ability to pick off the creatures from most parts of their bodies, they would doubtless suffer severely. It is a matter of common observation that the adult tick, even when abundant on an animal, is confined almost exclusively to the under parts. The favourite places of lodgment are the relatively bare places beneath the shoulders and about the genitals and udder; also between the toes of small stock and beneath the fetlock of horses. Yet while evidently preferring these places, the tick, at least in its larval and nymph stages, will thrive even amongst the thick hair on the sides and back of Angora goats and on the legs of cattle. The adult tick is not at all expert in climbing about in hair, and it is doubtless largely owing to this fact that it does not infest the backs of cattle. On man, the tick in all stages, shows a preference for the parts analogous to those most subject to attack in animals. This preference cannot be wholly ascribed to the location of the openings or the arrangement of the clothing, for native children, clothed in modesty alone, are most bitten in the same places.

*The Bont Tick, by Chas. P. Lounsbury, Government Entomologist, C.H.G. "Agricultural Journal," C.G.H., November 23rd, 1899.

"What wild animals are attacked I am unable to say from personal knowledge.

"While ticks of one kind or another are to be found practically all over the world and are well known for their injuries to stock even in the most thickly-populated countries, there has been almost up to the present a complete lack of exact knowledge regarding their food habits and life histories. It has long been a popular fallacy that ticks lived partly on plant food and partly on animal, and the studies upon which this report is based are the first, so far as I know, that explain conclusively how it is that ticks happen to be found on vegetation at different periods in their lives. The life history of the most common American cattle tick and that of the common Australian cattle tick have been traced in their respective countries, but these ticks remain on their hosts throughout their development from larval tick to distended adult. The same is true of our common blue tick.

"The Tortoise-shell female tick when fully distended with blood lets go her hold on the animal and drops voluntarily to the ground. She at once seeks a place for concealing her huge self, and appears quite restless until she gets at least the fore portion of her body hidden from the light. Should she fall in loose sand or road dust, she may burrow an inch or more down, but under the ordinary conditions found on the veld she contents herself with getting well out of sight in the midst of a tuft of grass or in some such situation. Having satisfied herself with the surroundings, the tick becomes practically dormant to all outward appearances. The mass of food matter contained is then slowly assimilated and eventually becomes transformed into eggs. Ten or eleven weeks may elapse in cold weather before this change from blood to eggs has advanced sufficiently for her to commence egg-laying, but in summer the period is sometimes as short as two weeks and perhaps sometimes even less.

"The number of eggs which the female lays is enormous. L. J. Roberts estimated the number in one batch he had under observation at 13,260. Fuller counted 6,000 in one batch and then computed the remainder to be about 11,500, thus calculating the total to be about 17,500. It is probable that the complement varies with different females all the way from 10,000 to 20,000. Each egg is laid singly, and it is an interesting occupation to watch the female slowly add to the pile that accumulates in front of her.

"An attempt was made a year ago to count the number of eggs laid daily by a female. It was found that the number varied greatly from day to day. During one interval of two days only 18 were passed, while on the following day there were no less than 370 in twenty-two hours, or an average of one in three and one-half minutes. In the summer, or when kept warm in an incubator, the deposition of the mass is complete in a much shorter time than in the winter at ordinary temperature; the periods in the instances observed varied from three to nine weeks, the shortest being the record of an incubated specimen. The normal period out of doors in summer is probably at least six weeks, this inference being drawn from one kept outside in a match box. The tick grows very feeble towards the finish and dies with the completion of the task without changing her position; therefore if she is not disturbed from start to finish, her hard, shrivelled and discoloured remains are to be found in contact with the mass of eggs.

"The eggs are oval in outline and of a glistening, light, reddish-

brown colour. They are slightly larger in size and lighter in colour than those of the blue tick. The shell is almost transparent. The contents at first appear granular and as development proceeds a pair of linear white organs show through; finally appendages of the body become discernible. If kept too dry and warm, and ofttimes under other circumstances, the eggs cave in all along one side and dry up. It takes very little moisture, however, to keep them properly, and the hatching does not depend on the occurrence of rains, as appears to be a current belief. In cold weather the development is very slow, and we have had eggs at the office, laid in the middle of the winter, remain unhatched up to the following January. In summer the incubation period is relatively shorter and the first eggs hatch a few weeks after the last in the batch are laid. Some eggs laid on January 26th, isolated and kept in the office, began to hatch on April 13th, or eleven weeks later. It does not seem likely that they would have hatched sooner on the veld than indoors when one considers that it is the habit of the mother tick to hide herself and that the night temperature is, as a rule, lower out of doors than in.

"The larval ticks or "seed ticks," as some people prefer to call them, are very unlike the adult tick in appearance. It lacks the "bont" characteristic in both body and legs, and instead of eight legs it has but six. It may be distinguished from the larva of the blue tick by its relatively larger size and longer rostrum, but it takes a practised eye to tell the two kinds apart unless they are side by side and a magnifying glass is used. It is, of course, a tiny fellow, and even with its rostrum included its length is only one-fortieth of an inch; the blue tick larva is just one-fiftieth.

"The larva waits indefinitely for an opportunity to get on to a passing animal, but there is, naturally, a limit to its endurance. As months go by it gets thinner and thinner, and a white mass accumulates in its abdomen. It is entirely improbable that any nourishment is derived directly or indirectly from the vegetation or other surface to which it may cling while waiting, for in blissful ignorance of its whereabouts, it waits just as Job-like and with seemingly equal vitality when tightly stoppered in a glass tube in which no provision is made for any moisture or even change of air. Many thousands, hatched between April 13th and May 15th, are still alive in a small bottle at the office as I write (in November), and there is not yet any indication of their becoming discouraged with life. Always as soon as disturbed the little fellows get restless, but finding nothing to set their teeth in they soon quiet down at the top of the bottle toward the light when let alone; there they are wont to rest in a single mass a full quarter of an inch thick.

"There does not seem to be much sense in a larval tick nor, for that matter, in any tick. The larva clings to anything that touches it, whether the "anything" be the hair of an ox, a person's clothes, or a piece of waste paper. To one watching it, it seems the essence of stupidity. Let it crawl on to a part of an animal where it is most likely to take hold, say the udder of a cow, and the chances are about ten to one for its dropping off. But patience, that virtue of virtues, offsets the failing of stupidity; and, as it did to Bruce's spider, success comes with repeated effort.

"For a few days after the larva attaches itself to an animal there is little change in its appearance, but about the fourth day it begins to swell perceptibly with the nutriment it has drawn. I say "nutriment" and not blood, because some individuals, as is shown

by their white and pink colour, become gorged with fluids that are not blood. In from four to nine days, but generally in six or seven, the larva is fully distended, and then, letting go its hold, it drops to the ground or on to whatever may be beneath. The larvæ studied had their fall intercepted by a cloth suspended to catch them. Now that it is off, the tick's one great idea is to get out of sight, and if given natural veld conditions, it promptly proceeds to install itself under a bunch of grass or just under the surface where the soil is loose. At this stage the tick resembles in form and generally in colour a mature female of the blue tick; but although it is a giant to its former hungry self, it is still a diminutive fellow and measures only a twelfth of an inch in length. Only the body has enlarged, the appendages and rostrum remaining just as before while the skin stretched. After secreting itself, a gradual change takes place within the body. For awhile the tick appears as if dead, but after a lapse of some weeks the skin ruptures and out steps a creature of quite different appearance. This transformation was hastened by artificial heat in the case of one batch studied in the investigations, and was complete with the first appearing specimens in sixteen days. None of two other large batches, kept in a sheltered, sunny situation during the daytime and indoors at night, started to moult before seven winter weeks had expired. None of a fourth batch, kept on the window sill of a cool room, where they only got the morning sun, showed any signs of the change at the expiration of the seventh week; they were then transferred to the incubator and kept heated to about 100 degrees, but still moulting did not start until two weeks more had gone by. Under veld conditions the period must vary with the season and situation, probably from one to three or more months. After resting for several hours to permit its skin to grow firm, the new moulted tick, now in the nymph or second stage, begins to explore its surroundings. With the change of skin, the rostrum and legs have become larger and stronger, and the latter eight in number where but six were before. The body is now flattened from above, brown in colour and egg-shaped in outline. There has been no change, however, that would lead one to connect the tick with the adult stage of life. Its behaviour now is much the same as when a hungry larva. It generally ascends some point of vantage and there awaits an animal. Naturally, since each tick dropped apart from its fellows when a distended larva, it does not form clusters with its mates, but is found alone. Its tendency to crawl upward and to the light, though strong, is less developed than before, and its patience at waiting is considerably less. For most of the time it waits with its legs curled beneath it; and this may be on a grass top, on the bare ground, or on a fence post, or almost anywhere off an animal. Occasionally it gets restless, even when there seems nothing happening to disturb its quiet, and off it starts to make a tour around. Movements in its vicinity usually bring it to an attitude of strict attention, with its fore legs held outwards and upward at full length. If it seems satisfied that food is near, off it goes on all eight legs in what it probably supposes is the right direction, but which, as far as I have been able to determine from watching numerous individuals placed on the ground near an animal, may be an entirely wrong direction. It generally feigns death if picked up in the fingers or rudely touched, and as in its earlier stage of life, it may get on to an animal and tumble off again and again before making a successful hold. Nature has endowed it with a wonderful vitality, and at the office are some still hungry but

active specimens that have been waiting fifteen weeks in a glass jar. There seems no reason why it may not live at least three months on the veld, and in this long time, it is a very thinly pastured country that does not afford it a number of chances to attach itself to some kind of stock.

"When at last its efforts to attach itself are crowned with success, it takes from four and one-fourth to eight days to gorge itself to repletion. Why it takes some individuals nearly twice as long as others to fill their skins is not clear, but it may be due to the variable amount of blood to be drawn from different tissues. There was no difference in the limits between those reared on goats and those on a cow.

"The distended nymph is plump and well rounded out, and no wonder, for the skin has stretched until it contains forty times the weight it did previously. The legs, shield and rostrum have undergone no change, so they now look small in comparison with the body, which has become a quarter inch in length. The colour has changed from brown to bluish-grey, and this colour is quite uniform in all specimens. Again the tick is active and promptly proceeds to search for a place in which to conceal itself. Gradually the powers of motion are then lost and the transformation to the third stage begins. Eleven weeks elapsed in the case of one batch under observation before the change was complete in any of the specimens, but in the case of different batches incubated, the nymphic skins began to rupture on the eighteenth, twenty-second, twenty-fourth and twenty-eighth days respectively. The period is a variable one with different individuals, some treated precisely the same as others taking a fortnight longer to moult. This second shedding of the skin brings the tick to the adult stage. Now the ticks which before seemed as much like one another as peas from the same pod are divided between two distinct types; these are recognised respectively as male and female tortoise-shell ticks.

"The two sexes appear in approximately even numbers. They are alike in size, but, as before described, dissimilar in colour and markings. One pays no particular attention to the other, and as they behave alike we may for the present consider them together under a common term. Again a tendency is shown to travel towards the light, but it is much less apparent than before, and ordinarily the adult is most at home on the ground while waiting for a host. Much time is expended in resting either with all eight legs bent beneath the body, or with the front pair held aloft, but more exploring is done than was the wont of the nymph. If placed on loose soil it will bury itself just beneath the surface or get its head out of sight; it may be that such is the customary habit when awaiting a host. A movement near it is generally sufficient to attract its attention and to start it running rapidly. It may be that under perfectly natural conditions, it usually runs in the proper direction, but I have not been able to affirm this by placing an open box containing a good number of specimens in the immediate neighbourhood of a cow. The movements of the cow or something else drew the ticks' attention, and although many wandered several yards in an almost straight line, it was never toward the cow. Several times I have dropped a number on the ground just under a cow; some ran one way and some ran another, but none up the cow's legs, although a few crawled over the hoofs and kept on in the direction in which they had started. All eight legs are generally used in running, but sometimes locomotion

on the six hind legs at a slower pace finds preference, in which case the fore legs are held stiffly aloft, or waved to and fro. That some sense of perception is located in the fore legs there can be no doubt, but as to the nature of this faculty I can now offer no definite suggestion. Ofttimes when the fore legs are held aloft, the tick will come to a sudden halt, and then change its direction, sometimes even turning on its track.

"In common with the earlier stages, the adult has vitality to tide it over many failures to fasten on to passing animals. The longest that one may live without food has not been determined, but some that moulted three months ago are still alive and vigorous. As a rule, it feigns death when rudely touched and often when only disturbed; but sometimes, when apparently much excited, it fails to do this. If applied by hand to the skin it rarely takes hold, seemingly wanting to hunt its own game. In the studies it was liberated in a cloth suspended beneath the animals and there left to take hold when and where it chose. A hungry specimen that has once bitten, however, will generally start to bite again without delay when held against the skin.

"The first adults reared in the studies had a cow as their host. Only about one-third of the males liberated in the cloth took hold. Females were liberated under the same conditions in small lots on four successive days until seventy had been given an opportunity. One only of all this number chose to please us, and she took up a position by herself. We were puzzled and sorely disappointed, and in our ignorance thought the cow must be one of those rare tick-proof oddities. A Kerry-Holstein cross in splendid condition was next offered. Half the males took, which was an improvement. The next day double as many females as there were males attached were placed in the cloth, and on the following day about as many more; all, however, were steadfast in holding out for something better, and what did not escape from the cloth were found dead or dying in it. What the "something better" was I did not discover for some days. Then I renewed the attempts. Twenty females were dropped into the cloth and in a few moments I loosened a corner to see what was happening. Great was my surprise at the sight I beheld. Pushing and crowding each other about one lone male were six excited and quarrelsome members of the opposite sex, four were about another and two more fought over a third. Wholly unexpectedly I had intruded at the scene of the ticks' love making, and now I was able to infer the reason for my past failures to make the females take hold. For obvious reasons, it is undesirable that the sexes pay attention to one another until they meet on an animal. All the energies of both are needed to sustain them during the long fast they may have to endure. Nature accomplishes her object in keeping them separated by providing that the male remain ineligible and without passion until he has fed for a number of days. To the female she assigns the courting. Thus while the male's supreme idea after moulting is to find an animal to bite, the female's is to find a male that will have her for a mate. The male when he gets on to a beast soon settles down to attach himself, while the female when she gets on wanders about from male to male hunting for a suitable bosom companion. What sense faculty guides her in her search I do not know, but certain it is if she gets near an eligible mate she usually starts in a straight line towards him. When one of the "Barkus is willin'" kind detects the presence of a female near him, and he may do so while

his would-be mate is still five or six inches away from him, he becomes visibly excited. He straightens his body, which before was lying against the animal, until it stands out at right angles, and further expresses his desire for company by clawing the air with all eight legs. She rushes up, is caught and held by the legs, and in a moment the pair is in close embrace, the legs of each entwining the body of the other.

"The period after a male attaches himself, during which he remains unattractive, is a variable one. It generally extends at least to the fifth day, but may end as early as the fourth, or not until the seventh or later. Before he is ready he makes no sign of recognition when a female comes up, and she on her part barely notices him, at the most touching him with her fore legs. As already indicated, several females may simultaneously approach a male and quarrel with each other for his company; this, however, probably rarely happens on the veld. When it does, the vanquished ones may depart or, as seems the more usual custom, may settle around the attraction and wait for him to become a widower. How and when actual connection between the sexes takes place has not been determined. The male may tire of his companion after six or seven days and make signals of his willingness to take up with another, and the now cumbersome proportions of the first make it easy for a second to squeeze herself into the coveted position. In general, one female drops before another appears, and a long interval may elapse between successive matings. Females that fail to secure a mate owing to none of the males being eligible sometimes settle down without one, but this seems an uncommon habit. Only three out of one hundred and twenty given the opportunity did so among those applied to the cows. Two of these let go and were lost on the second day after they attached themselves. The third remained a week in the one position and was then found to have moved and to have secured a mate. From the scars, I inferred that the male had come down almost to the female, and that she had then turned about, moved up a quarter of an inch, and thus secured the embrace. The female in this case, and also several other unmated ones that have been observed, develope very little while alone; to draw conclusions from the only instances watched, three in number, it takes such females as long to become distended after meeting with a male as it does those that mate as soon as they get on the animal.

"For a few days after a female joins her companion, she enlarges but little; then she slowly swells and by the fifth day may be half distended. After that distention becomes more and more rapid and the increase from three-quarters to full size occupies less than a day. Complete distention is generally attained on the seventh or eighth day and the tick then lets go her hold and falls. Development may, however, be complete in six and one-half days, or may not be until the tenth. After falling, the tick roams sedately about, generally using six legs only for locomoting and meanwhile holding the front pair aloft, until a place for concealing herself is found. This concludes the round of her life. The male remains on the animal for many weeks.

"The male does not appear to ever suck blood when it is adult. It swells slightly in the direction of depth, and it is therefore presumed that it does derive some nutrition from the animal it infests. A slight suppuration always occurs at the wound, and this place may not heal for a month or more after the tick has been removed or has left of its own accord.

"The life cycle of the Tortoise-shell Tick is seen to be one of variable length. The winter, though by no means a cold season, retards the development of all the life periods passed off the animal. At the very least I estimate nine months to be required for the completion of one cycle; and I believe that under exceptional circumstances two full years might pass and the cycle be still incomplete. Ordinarily, there cannot be more than one full generation in the course of a twelvemonth.

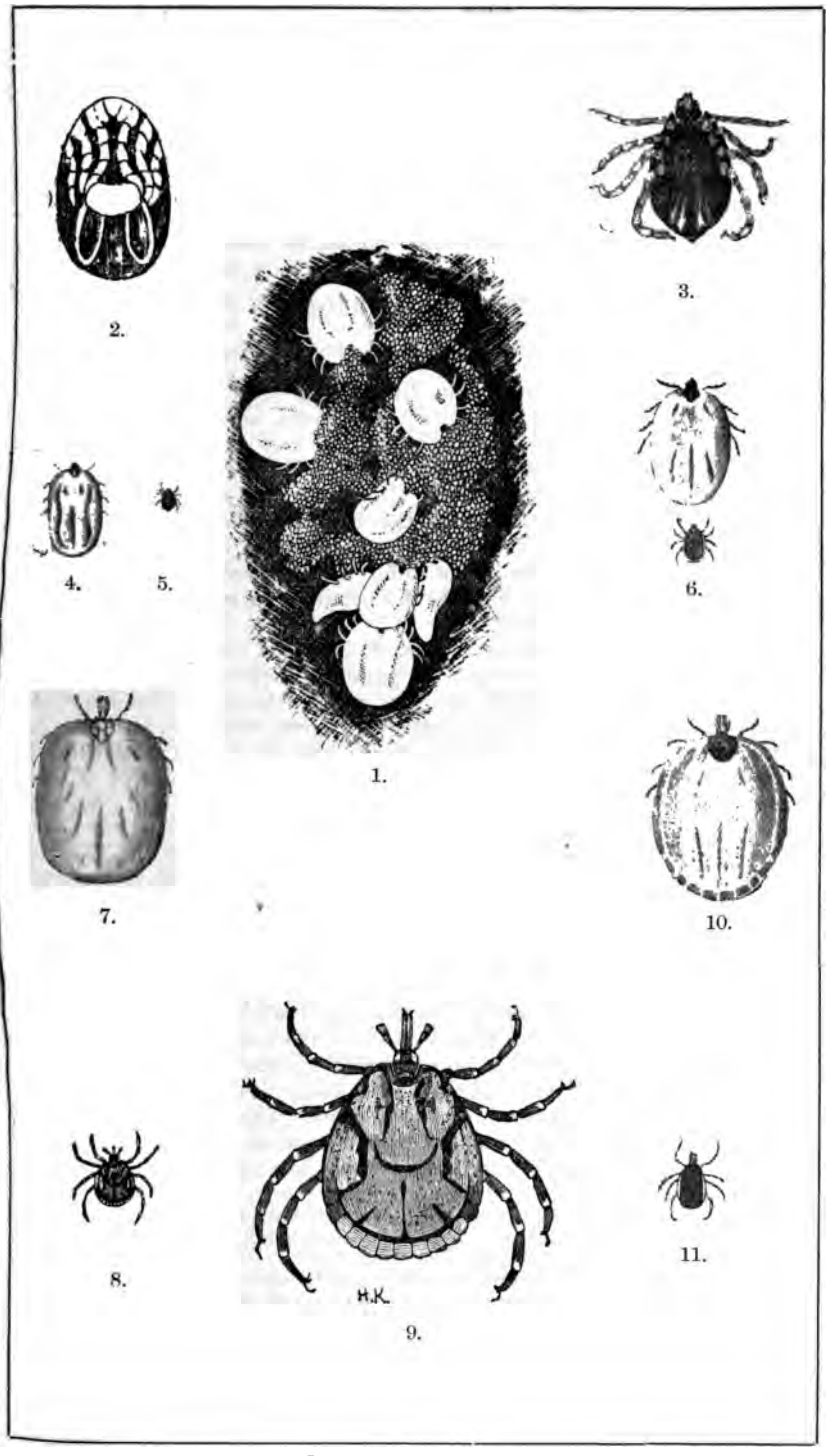
"The mature ticks appear to be most abundant during the late summer and autumn months, but are to be found all the year through. From the dates of the hatching of the hundreds of thousands of eggs in the office here, it is inferred that the larval ticks are most common in mid-summer. As the summer warmth accelerates the development of the various stages to a very marked degree, it seems to me probable that fully double as much towards destroying the ticks on the cattle may be done between December and May as during the remaining months of the year.

"As farmers who have this tick on their farms know only too well, large festers often form where the animals are attacked. The teats of heifer calves and even of grown cows not infrequently become involved and so much injured that they slough away or become useless for their proper function. The precise origin of these sores has not been determined. As none have appeared on the animals infested for these studies of the life history, it is evident that they are not necessarily caused by the simple presence of the tick. Possibly they arise from pieces of the mouth organs being broken off and left in the flesh when the bodies of the ticks are forcibly removed through intent or accident. The irritation of the tick-bites causes animals to lick and rub the affected parts, and in these efforts to obtain relief it may be that an occasional tick is torn away, leaving part or all of the rostrum embedded in the flesh to putrify and start the evil. On horses it has seemed to me that the sores are most common on the infested parts that chafe in travelling; the chafing naturally wears away the ticks, and I have often removed males so worn by friction that the markings of the back were obliterated. There is also a bare possibility that young ticks feeding by sores imbibe the bacterial organisms to be found therein, and that these, surviving in the ticks, may be eventually transferred to an animal again in such a manner as to reproduce the festering.

"Ticks of various kinds have been credited by different people with leaving an animal the moment death takes place. My observation does not confirm this statement. Mr. Roberts shot a badly-infested cow while I was at Cottesbrook, and I was particular to watch the behaviour of the ticks. None but a few fully-gorged Blues fell off at first. The pelt was removed and spread out on the grass. There were several dozen male Tortoise-shells and plenty of Blues and Reds and a few Striped Legs present. Many of the males of all four kinds and a small proportion of the females detached themselves and wandered about the skin on the second and third days; but the majority of all kinds remained attached up to the fourth day, when because of the unbearable stench I discontinued my observations. Later it was observed that vast numbers of the ticks had dried out without disengaging themselves.

"Again, it has been stated that ticks forcibly removed and thrown down in a road pursue a straight course back to the animal, while fully distended females that drop voluntarily make straight for the

PLATE XXIV.



Cattle Ticks.

roadside grass. I have experimentally tested the first assertion by throwing down Bonts pulled from cows, and have concluded that the wandering of the ticks is quite without a definite course to the beast; doubtless they wanted to get back, for such as I held against the skin promptly proceeded to take hold again, but their movements on the ground were decidedly erratic. The second assertion is also open to doubt. I have followed ox-wagons near Grahamstown and looked to see what direction the distended females took when they fell off; quite as many, I found, travel with the road as the other way, and some that were watched were so foolish as to bury themselves in the road dust."

THE BLUE TICK.

Rhipicephalus decoloratus, Koch.

Undoubtedly the small blue tick is the most common species in Natal. It is chiefly interesting upon account of its association with the disease of cattle commonly known as red-water. *R. decoloratus*, which was originally described by Koch as far back as 1837, from an immature female, is very much allied to *R. australis*, mihi, and *R. annulatus*, Say. The former is the red-water tick of Australia and South America, whilst the latter is intimately connected with the disease in North America. The differences between the three species are not great, and I have already discussed them in the "Agricultural Journal" of Cape Colony.*

Naturally, red-water as a disease does not come within my province, but, before discussing this parasite further, I would like to assure farmers that this species and others, do convey red water and, moreover, convey it through from one generation to another. It is also equally true that ticks become dissociated from this disease, as is evidenced by the fact that ticks exist in the Western Province of Cape Colony and red-water does not, and imported cattle do not suffer from this disease in that dsitrict.

Natural History.

The natural history or a study of the cycle and habits of this species I have not attempted as yet, and the remarks which follow are based upon observations made by various parties in Cape Colony, Australia and North America.

For the purpose of discussion the eggs may be taken first. These are laid together in a little mass. They are dark brown, ovoid and opaque at first, but shortly before hatching the young ticks become more and more apparent within shells, their development being first indicated by the appearance of a white spot. The period which elapses between the laying and hatching of the eggs is of course variable in accordance with climatic conditions, being less in warm weather than

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Explanation of Plate XXIV.—Fig. 1, group of adult female Blue Ticks laying eggs, natural size; fig. 2, egg of tick just before hatching and showing embryo within, much enlarged; fig. 3, male Blue Tick, ventral view, much enlarged; fig. 4, replete female Blue Tick, natural size; fig. 5, adult male Blue Tick, natural size; fig. 6, male and female Red Ticks (*Rhipicephalus Evertsi*), natural size; fig. 7, replete female Tortoiseshell Tick (*Amblyomma hebraeum*), natural size; fig. 8, adult male Tortoiseshell Tick, natural size; fig. 9, the same greatly enlarged; fig. 10, replete Striped-leg Tick (*Hyalomma ægyptium*) natural size; fig. 11, adult male Striped-leg Tick, natural size. (Figs 8 and 9 after E. A. Ormerod, remainder original).

* The Common Blue Tick of Cape Colony and its Relationship to the Red-water Ticks of N. America and Australia. *Agricultural Journal*, Capetown, March 16th, 1899.

in cool. As a rule it may be put down as from three weeks to a month. In hatching the egg-shell splits and the young tick makes its exit. It now, like the larvæ of other ticks, is anxious to reach a host, and to this purpose Nature has filled it with a desire to seek some point of vantage, and this it proceeds to do, making use of any elevated stand that it can secure. Grass heads and tips of long grass blades are particularly favoured, and there on bright days they will cluster in abundance, waiting patiently for the passing of a host, and alert to seize upon it at the opportune moment. The hosts of the blue tick are chiefly cattle and horses, but they may occur upon other farm animals, and dogs and hares.

Having gained access to a host, the young or "seed ticks," as they are often called, attach themselves to the skin. Mr. Lounsbury has pointed out that in this respect ticks do not show that amount of "instinct" with which we are prone to credit them, and his opinion I can heartily endorse. Still, as regards this species, it is safe to say that the larvæ attach themselves more readily and rapidly than do those of other species which have been studied in this connection.

The larvæ of the blue tick are capable of living without food for some time—those of the Australian tick having been kept for over four months without food, whilst larvæ from an allied species were kept alive in this office in a glass stoppered bottle for five months, from February to July. When first hatched the "seed ticks" are whitish, but they gradually become a reddish brown colour. They have six legs and no sexual organs. Of the six legs the first pair are more highly developed than the intermediate and hinder pair, being provided with sense organs and acting as feelers. The mouth parts are well developed and suited for piercing the skin and hanging strongly thereto when once well embedded. It takes but six or seven days' feeding before the larvæ are ready to moult, or cast their first skins, and this they do without leaving the host, as does the Tortoise-shell described above. In the change from the larval to the next or nymphal stage the old skin is completely discarded, and upon emerging from it the tick is found possessed of an extra pair of legs and two well-defined respiratory organs. The term nymph is applied to this stage as it is homologous with that stage in the development of insects with incomplete metamorphoses, such as the bugs.

The nymphal ticks, like the larvæ, have no sexual organs. As with the earlier stage, this also lasts about a week and then the second moult occurs, and once more the skin is completely thrown off. A great change now occurs, for the sexual organs are developed, and the two sexes, male and female, are distinct from one another.

The males can be recognised at once by their smaller size, by the fact that their backs are covered entirely by a hardened brown shield and also by the small conical tail and the four triangular, horny elevations upon the abdomen. The female resembles the nymph somewhat, except that the shield behind the head is larger and stronger and the legs more developed. The external genital organs of both species are to be found between the haunches of the anterior legs, and are alike in both sexes, presenting the appearance of simple openings.

Throughout his existence the male varies little, becoming, if anything, but a little thicker. The female, however, grows to a comparatively very large size, her body becoming greatly distended with blood, so that she bears scarcely any resemblance to the male. Her head, legs, and breathing pores do not, however, increase in size, and

consequently, when compared with the body, look much smaller than they did before. One of the earliest acts of the male tick is to seek a female, and it then attaches itself to the beast so that it can with convenience embrace the female, bring itself belly to belly and have the genital organs in apposition. In this position both sexes can usually be found, although the small size of the male often causes it to be overlooked. But a little while is taken by the female to engorge herself—three or four days being ample—she then disengages her proboscis from the skin of the beast and falls to the ground. This she does to lay her eggs, for which purpose she hides in some dark spot or seeks the shelter of a friendly stone. In the summer months she begins to deposit her eggs in five or six days to a fortnight, but in autumn and winter this act may be delayed for a considerable period. The time spent by this tick upon its host varies from three to four weeks in summer, and two to three months in winter.

The adult male measures about one-tenth inch in length. It is of a dark brown colour, at times, but usually pale and somewhat transparent. The back is smooth and shining, and the body terminates in a well-defined horny point. Upon the abdomen and on either side of the anal orifice are two pairs of horny elevations, which taper to rounded processes at the posterior extremity. These four processes are often visible when viewing the tick from above. The barb is furnished with six rows of teeth.

The adult female, when gorged with blood, measures about half an inch in length and a quarter of an inch in breadth. The colour is a slate blue underneath and of an unpleasant bluish green above The legs are reddish yellow. Behind the head and on the back of the body is a triangular shield. This is divided into three regions by two longitudinal furrows, the central portion being light yellow and the lateral areas red.

THE STRIPED-LEG TICK.

Hyalomma ægyptium, Audoin.

Among the other species of ticks which occur in the Colony the Striped-leg Tick may be mentioned. This species is as large a tick as the Tortoise-shell Tick described above, but the female is readily recognised apart from it by the absence of the brilliant markings on the shield and by the white rings upon its legs. The male also differs considerably from that of the Tortoise-shell, being of a more oval shape and having the back almost black and margined with two pale stripes. This species is known as the Bont-leg Tick in Cape Colony, where it is more common than in Natal, very few specimens having come under my observation.

The following notes upon the species are extracted from the 1899 Report of the Government Entomologist of Cape Colony.

"The Bont-leg Tick, (*Hyalomma ægyptium*, Audouin).—This species of tick has been received or collected from nearly all sections of the Colony and is particularly pestiferous in the Midlands and the north-western sections. It is found about Capetown, but not in numbers. While its life stages have not been consecutively studied, observations of value have been made on them. In the adult stage, the species is nearly equal to the Bont in size, many specimens of repleted females measuring no less than three-quarters of an inch in length. And like the Bont, this species possesses a long rostrum, and frequents the under and comparatively hairless parts of the animal. All farm

stock seem subject to attack but sheep and goats suffer most severly. The life period is probably far shorter than in the case of the Bont as all the stages observed have been of shorter duration. Under ordinary conditions, however, it is unlikely that more than one generation occurs in the course of a year. Eggs laid September 18th and onward began to hatch December 6th; others laid October 19th and onward began hatching November 25th; others laid December 11th began February 6th; and a fourth lot, from females which started to lay January 5th, or two weeks after being removed from goats, began to hatch February 15th. Thus the period from the dropping of the females to the appearance of the young may in summer be as short as eight weeks; the shortest corresponding period observed in the case of the Bont Tick was nearly fourteen weeks. The longest corresponding period in the case of the Bont-leg was six months, and in the case of the Bont, eight months. Unfed larvæ of the Bont-leg Tick have been kept in a tightly-stoppered tube without moisture from mid-January to early August or full six and one-half months. The larvæ and nymphs leave the animal to moult. Small lots of larvæ have been reared on a goat and the dropping observed to occur in three and one-half to four and one-half days. From certain actions, it is inferred that the females seek the males, but I have no definite knowledge on this point.

"No data have been obtained which tend to explain the relative abundance of the Bont-leg Tick in the Karroo compared with the more moist coastal districts. On the other hand we have indications that the species is well fitted for a dry climate. Batches of its eggs kept at the office in dry card-board boxes have hatched, while batches of eggs from the Bont Tick and from the Blue Tick kept similarly have unifomily lost vitality. The long drought of 1897-1889 in the Midland districts did not appear to affect its numbers. Mr. R. F. Hurndall, of Aberdeen Road, informed me that there was fully as many on his goats during the rainless spring of 1897-1898 as during the previous good seasons.

"The common name assigned to the species is suggested by the "bont" or variegated features of the legs of the adults; the outer part of each joint of the otherwise brown legs is whitish. The male above is almost black with a pale marginal stripe. The replete female is brown with irregular light blue stripes."

THE RED TICK.

Rhipicephalus Evertsi, Neumn.

The Red Tick is another species which I have taken several times, but which is certainly not nearly so abundant here as in Cape Colony. As with former species the only studies into its natural history which have been attempted are those made by Mr. Lounsbury and for general information his notes, extracted from the above-mentioned report, are again quoted.

"The Red Tick is another species widely distributed in Cape Colony, and whenever I have seen any ticks at all on an animal, I have almost invariably seen at least a few of this kind. Severe infestation is, however, exceptional. The adults are remarkable for their decided preference for the hairless parts of the skin adjacent to the anus. Fifty or more may be clustered thereabouts when none are to be found elsewhere. The larvæ and nymphs likewise are partial to a particular part, congregating in the ears; few are to be

found in other situations, and almost all the ticks that I have taken from the inner surface of the ears of animals have been of this one kind. The nymphs somewhat resemble distended females of the Blue species, but are very much smaller; they measure about three-sixteenths of an inch in length. The adult male is a dark reddish-brown, almost black, above with a narrow paler margin. The female is of the same shade on the front of the back (the shield) but more distinctly reddish-brown behind. Both sexes are much longer than wide, more so than most ticks. Before distension, both measure from one-eighth to three-sixteenths of an inch in length; after distension the female measures up to two-thirds of an inch. The legs are much paler in colour than the back, being dark-amber in clour, and by this characteristic the species may be easily distinguished from a near ally, the Larger Blue (*Rhipicíphalus bursa ?*) The latter tick much resembles the red in shape, size and colour but has dark-red legs. A remarkable feature in the life cycle of the Red Tick is that the first mould, that from larva to nymph, is passed *on* the host whilst the second moult, that from nymph to adult, is passed *off* the host. After the moulting on the ground, the adults climb grass or bush and await the passing of animals as do the larvæ. These waiting Red Ticks are a familar sight to most of our farmers. The Larger Blue waits similarly while Bonts and Bont-legs generally lay half hidden on the ground. Eggs of the Red Ticks have several times been successfully incubated at the office in glass-topped pasteboard boxes without moisture or shelter from light. The nymphs have been found to moult without moisture; and this indifference to a dry atmosphere probably accounts for there being almost as many of this species of tick on open pastures as in bush-covered country. A systematic study of the habits of the tick in all its stages is now in progress."

THE FOWL TICK.

Argas persicus.

This is very distinct from the ticks already mentioned, and is characterised by having the mouth situated upon the underside of the body. It is common on fowls throughout Australia, in parts of Cape Colony and in India; but in only one case have I found it in Natal, and that was in a hen-roost in Maritzburg.

The males and females differ chiefly in point of size, but in the adult stage can be recognised apart by a study of the external genitalia which, as in the case of other species, are found below the mouth. (*See Plate, XXV., figs.* 1—5).

The life history of the species may be briefly outlined as follows:

The eggs are somewhat spherical, of a brown colour, and resemble small beads. They are laid in cracks and crevices and beneath the boards and rubbish common to the general run of fowl-houses.

The larvæ which hatch from these, like those of other ticks, are six-legged. They are of a pale colour and somewhat transparent; the arrangement of the internal organs being displayed, in a measure, through the integument. In size they are about that of a pin's head, somewhat flat and ovo-triangular in shape. Unlike the adults, the mouth parts are terminal and not placed on the ventral surface of the body. In their arrangement, they resemble those of other ticks. The larvæ attach themselves readily to a host, generally locating themselves under the wings. They remain fixed for about

five days, at the end of which period the body is greatly distended, somewhat kidney-shaped and of a bluish colour, on account of the blood with which it is gorged. The ticks now leave the host and casting their skins enter the nymphal stage. After this they seek the host again and, as Mr. Lounsbury has observed, moult twice, visiting the host after each moult. After the third moult the sexes are differentiated and the ticks mature.

The adult ticks are somewhat bug-like and of a brown or dull grey colour. They are oval in outline, broader behind than in front, much flattened and with a decided keel of a pale colour right around the margin of the body. The skin is much roughened and pitted a good deal with numerous small depressions. The legs are long, slender and white. The males are about one-quarter of an inch in length and do not increase in size to any marked extent. The females, however, increase to one-quarter and half an inch in length (*See Plate XXV., fig.* 1).

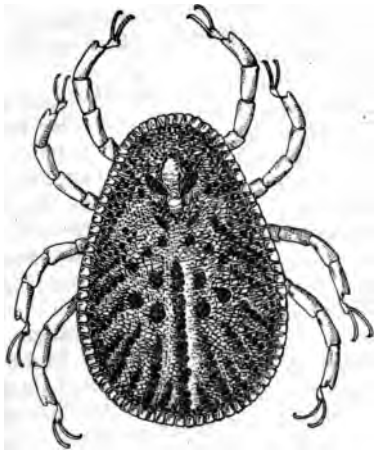
In its habits, after passing the larval stage, the Fowl Tick is strictly nocturnal; seeking the birds only at night and leaving upon the approach of daylight to hide away in some dark crack or cranny. The tick possesses a remarkable vitality in the nymphal and adult stages, and can starve for great periods. I remember one lot being sent to me when in New South Wales about June, 1896. These I kept in a tin match box and carried them with me to Western Australia in October of that year. They were then handed over to my old friend Richard Helms and from him I learn that the last of them died in August, 1897, having lived fourteen months without nourishment and confined in the small tin box all that time. Mr. Lounsbury kept specimens of this species for a year under observation and these had been stowed away for some considerable time, probably eight months, before a strict account was kept of them.

Both fowls and ducks are said to die from the attack of this parasite and there is fairly good evidence pointing to the correctness of this assumption. There is some difference of opinion, however, as to whether death is due to the loss of blood or to the transmission of some contagious disease. Personally, I am inclined to think that in some cases death is due to loss of blood and in others to the transmission of disease.

THE BEE SCORPION.

The bee scorpion, or, more correctly speaking, the bee chelifer, is a small animal related to the scorpions, which is found very commonly in beehives in Natal. This little animal rather resembles a lobster, having a pair of huge mandibles or pincers quite out of proportion to its body. On examining a hive it is usually found running over the combs and frames and in and out amongst the bees, or else in cracks, enclosed in a little circular cocoon of white silk. It evidently spins itself up into this cocoon to undergo a moult, and its presence in the hive indicates that its life may be closely interwoven with that of the bees. So far as the bees are concerned, however, they take absolutely no notice of the intruder and, except in the soft state in which the chelifer is found in the cocoon, I doubt if the bee did attack it whether it could have any effect upon its horny body.

This chelifer belongs to the same group of small animals as the scorpions, spiders and ticks which, as has been pointed out in another part of this report, are not true insects, but near relations; differing essentially in having eight pair of legs and the body divided into but



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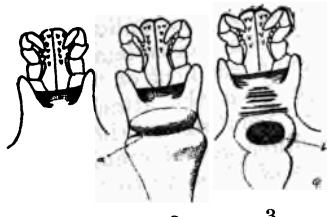


4. 2 3

5.

The Fowl Tick.

6.

7.

The Horse Bot.

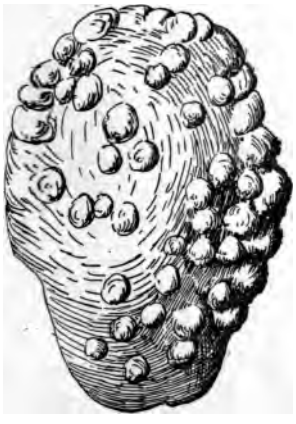
two regions. Like insects, however, they go through three stages of existence from the egg. and moult their skins in the course of their growth. Many chelifers are known to make use of flying insects as a more rapid means of transit than they themselves possses. This they manage by fastening to the legs of their hosts by the aid of their large pincers. No doubt this is how the bee chelifer reaches the hive in the first instance, being carried there by returning bees. Bee-keepers I have met are of opinion that they cause no harm or inconvenience to the bees and, so far as I am at present aware, may be but casual lodgers in the hive.

Explanation of Plate XXV.—Fig. 1, the Fowl Tick (*Argas persicus*) greatly enlarged; fig. 2, genital orifice of female; fig. 3, same of male; fig. 4, showing absence of any orifice in immature tick; fig. 5, young or larva of fowl tick, greatly enlarged. Fig. 6, the Horse Botfly (*Gastrophilus equi*), enlarged; fig. 7, Bots or larvæ clinging to stomach wall, reduced (fig. 7 after H. Osborne).

POTATO GALL WORM.

The attack of this minute worm upon potatoes is not very common in local crops, and only upon two or three occasions have I seen it, but then it has been very bad. Its attack may be at once recognised by the numerous rounded swellings or warts which result. They are very characteristic and disfigure the tuber considerably.

The potato gall-worm is not an "insect," but belongs to a large series of worms known as "nematodes." These are mostly small, elongated creatures and are sometimes spoken of as "thread-worms," from the likeness some of the larger species bear to a piece of thread. They are as a rule parasitic in their habits, and all animals and many plants suffer from their attack. The potato gall-worm is parasitic upon many other plants as well, being particularly partial to all root crops.



Potato infested with Gall Worms.

In the case of potato attack the worms, which are of microscopic size, crawl through the soil and bore into the tissue of the tuber. Here, it is said, the males and females mate and there they multiply until they may number many thousands. The formation of the tumours or galls upon the surface is due to the irritation set up by their presence and, by examining such swellings in the following manner, the worms may be detected. A very thin slice of a gall should first be cut with a razor or a sharp penknife and lifted with a little water on to a piece of clear glass. Upon holding this up to the light, milky-white spots will be seen embedded in the clear tissue, and these are female worms swollen up into a pear-shaped sac by the multitude of eggs within them.

Treatment.

There is no remedy for gall-worm, but the attack may be prevented, and this is best done by avoiding infected seed. Should a field, however, become infested an effort should be made to rid it of the pest and for this purpose several methods may be employed. The first is by starving out the worms, which may be done by keeping the

infested soil free of all vegation for a year or eighteen months. The second plan is to carefully cultivate it with a rotation of crops, sowing only those which the worms do not thrive upon, such as mealies and forage; and rigidly excluding those that they particularly favour, such as potatoes, turnips, mangels, etc.

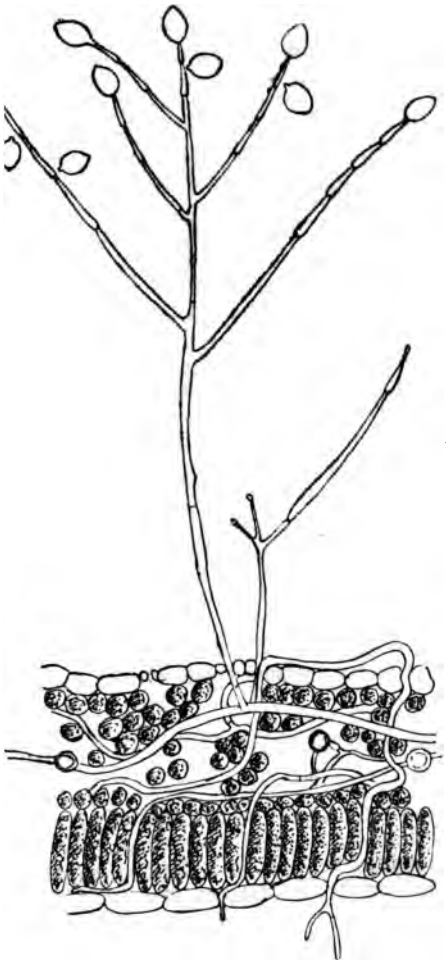
A third plan is one whereby the worms may be captured and destroyed, and it has been devised and carried out with success in Germany, where "beet sickness," due to gall-worms, seriously affected the beet-sugar industry. It has been found that after the worms enter the beetroot they do not reach maturity for five or six weeks, and advantage is taken of this knowledge of their natural history to plant early "trap" crops of beet, which were pulled up and destroyed before the gall-worms have reproduced and escaped into the soil again. The result of this practice is said to be brilliant.

FUNGUS DISEASES.

Introduction.

The nature of fungus diseases is very imperfectly, if at all, under-
d by most farmers with whom I have come in contact, and hence
ve thought it desirable to preface the accompanying notes with a
t introduction.

Everyone has noticed that, with few exceptions, the plants which
e under everyday observation are green, and a few are acquainted
ı the fact that this green colouring-matter or chlorophyll exercises considerable functions in the preparation of the foods, collected from the soil by the roots, for assimilation by the plant. Chlorophyll is dependent for its development upon sunlight, a fact of which one is easily convinced by the yellow growths put forth by plants growing in darkness, or by grass, over which a bag has been laid for some time. The development of chlorophyll is also, in some manner, dependent upon a sufficient supply of iron, and this has been demonstrated by growing plants in nutrient solutions free from this mineral. Plants so cultivated produce only yellow leaves—except the first few which are green, a circumstance no doubt due to the food supplies stored up in the seed—and these yellow leaves can be changed to green by the addition of iron to the solution in which they are growing, and even by the application of solutions containing iron to the leaf's surface.



ction through a piece of potato leaf, with potato fungus growing in its tissue and emerging through the epidermis, x 100 (after G. Worthington Smith).

The function of chlorophyll is described as the absorption of carbon dioxide, the evolution of oxygen and the formation of new organic substance. In other words, it is by the aid of chlorophyll that green plants are able to subsist upon inorganic substances, ch as are obtainable in the soil, and convert them into organic matter.

Now a fungus is a plant, but it is destitute of green colouring atter or chlorophyll and consequently unable to assimilate inorganic

substances, and hence is compelled to feed upon organic matters, such being of course either of a vegetable or animal origin; for organic matter is only found in various living things or matter which has possessed life. The fact that fungi feed upon animals or vegetables or their dead remains enable us to divide them into two groups; those subsisting on living animals or plants being known as *Parasites* and those feeding on their dead remains as *Saprophytes*.

Saphrophytes are common upon dead wood, dead leaves, dung, etc., and common illustrations are the mushroom, toadstool and the bracket fungi so often noticed upon dead trees or logs of wood.

Parasites, on the other hand, find substance by attacking living organisms. There is a vast assemblage of these, some live on animals, but the great majority attack plants.

In their natural history or methods of growth and propagation different species of fungus parasites differ essentially from one another. It may be stated generally of them, however, that they originate, as do higher plants from seed, but in the case of fungi the seed, fruit or reproductive bodies are always spoken of as *spores*. Spores are always produced by a fungus in very great abundance and, unlike the seed of higher plants, one fungus may produce several very distinct forms of spores (see notes on "Forage Blight"). It is not necessary to enter into a detailed discussion of the many points involved with regard to the conditions under which these various spores reproduce their kind, but we may take a simple instance, such as is presented by the common Potato Blight of England, which has recently, I regret to say, been observed in Natal also. In the event of the spores falling upon a potato leaf and meeting with favourable conditions, such as warmth and moisture, they germinate. In germinating the spore sends forth a fine rootlet or thin-walled tube which progresses across the leaf until it reaches one of the many openings into the interior of the leaf, known as stomata, through which the plant "breathes." Having gained an entrance to the tissue this hypha, as the rootlet is technically designated, passes readily amongst the loose and soft cells absorbing nutriment from them and carrying destruction with it. Soon it branches and ramifies considerably, forming a net-work of roots, known as the mycelium, and shortly from this mycelium arise stalks which push themselves out through other stomata and branching bearing spores similar to that from which the parasite originated.

BARLEY BLIGHT.

Erysiphe graminis.

During the past season upon a number of occasions my attention was drawn to a disease affecting in no small measure barley crops. This, upon investigation, proved to be due to a fungus growth upon the blades, known in England as Grass Mildew and in America as White Rust. Its prevalence was, in a large measure, due, I believe, to the hot dry weather, though, at the same time, several irrigated fields also suffered badly. This fungus differs from most other forms inasmuch that the roots or mycelium do not penetrate into the leaf and ramify among the plant cells. Instead they spread over the surface of the blade, forming a white superficial layer, and adhering by minute suckers through which the parasite derives nourishment. Upon this white mouldy growth the spores are produced in chains like beads upon a string. These chains of spores are readily broken up and scattered, and each spore is capable of starting a fresh centre of disease and so con-

veying it from blade to blade and plant to plant as in the case of Potato Blight and Rust of Forage. In examining patches with a magnifying glass small black spots were also noticed in among the older areas of the disease. These represented another stage of the disease which, under the microscope, takes the form of spherical bodies clothed with numerous slender appendages. These bodies are called *conceptacles*, and each encloses a number of bladders which in turn contain spores. The object served by these complex conceptacles, it is said, is to carry the disease through the vicissitudes of winter, during which season they rest upon the ground.

In the spring they burst, and the small spores which they contain fly into the atmosphere. When these fall upon grass or another suitable host they germinate and speedily produce the white rust or mould characteristic of the disease. These facts are culled from Worthington Smith's interesting account of the natural history of the fungus under the climate conditions of Great Britain. How far they apply here has not yet been ascertained, but no doubt, with certain modifications, the natural history will be found very similar; and it is interesting to add that both the Oidium form of the disease, as represented by the bead-like chains of spores, and the conceptacles, were found during the months of May and June.

Treatment.

According to the author mentioned above Barley Blight is synonymous with bad, impoverished grass, with mildewed hay and ill-nourished herds and flocks in the old country. He says, in addition, that the natural history of the fungus teaches that all mildewed material should be destroyed as far as possible, and calls for clean farming, and he considers it more injurious in dry, warm weather than at other seasons. There is no fungicide that in common farm practice could be applied, though farmers have told me that they have prevented it by dusting the crop with salt, but whether the salt actually had the desired effect I cannot say. Possibly dusting with flowers of sulphur would have a beneficial effect, but I doubt whether such would be found practicable except over a small area.

MEALIE BLIGHT.

Helminthosporium turcicum.

This fungus disease has been noticed at Mooi River and at Richmond and is the Mealie Blight referred to by Mr. J. Marwick, of Richmond, in his notes under this heading in the "Agricultural Journal," August 3rd, 1900, in which he draws a distinction between Mealie Variegation and this disease. The disease is known in Southern Europe, the United States of America and Queensland as Maize Blight, and at times I understand does considerable mischief.

A field suffering from its attack has, as a rule, a sickly, yellow appearance, and looks as if suffering from poor drainage and an excess of water about the roots of the plant. In its incipient or early stage the disease may be recognised by the numerous small pale patches, somewhat circular in outline and quite distinct from mealie variegation, which appear in the leaves. These gradually increase in size and run together so that large areas, and at times the whole leaf, assume a pale yellow colour. These yellow patches soon turn brown and the tissue dying, drys up, becomes very brittle and breaks away readily. In one case which came under observation the whole of the plants in the field were suffering from a very uniform and

severe attack. The older leaves at the base of each plant were quite dead, the newest marked all over with small pale patches, and those intermediate in intermediate stages between the two extremes. Some were yellow throughout, whilst in others the tissue was dying from the tip downwards. In another case the disease appeared more in large linear patches upon the leaves and these readily broke away.

After the leaves have turned brown a very fine and delicate mould grows over the surface, which may be likened to a thin bloom. such as is seen on certain fruits but is much less conspicuous. Subsequently the bloom assumes a somewhat smoky colour, and if a portion of the affected part is examined microscopically it will be found that the bloom is in reality a very fine film of fungus growth spreading over the leaf surface and bearing a multitude of dark-coloured spores.

Treatment.

An important fact to bear in mind in connection with such a disease as this upon a mealie crop is that ordinary curative treatment is hardly practical, and so any treatment adopted must be more of a preventive character. The spores or fruit of the disease are spread about greatly owing to the brittle parts breaking away so easily and being carried by the wind and impregnating the soil with spores. In a bad attack the crop should certainly be burnt off as speedily as possible and a rotation of crops practised upon the infected field. I feel confident also that crops grown upon well cultivated and strong soils with good drainage will seldom suffer severely.

POTATO BLIGHT.

Macrosporium solani.

Potato Leaf affected by Early Blight.

Natal Potato Blight is the same as the Potato-leaf or Early Blight of the United States and appears to be far more destructive under certain conditions here than elsewhere. It is widespread throughout the Colony, and mid-season crops seem to be carried off under any circumstances. Early and late sowings are often more likely to escape the blight, but even in these cases there is always a fair amount of chance. There are some isolated situations in which I am told potatoes are never seriously affected by the blight, but it is impossible to ascribe any reason for this peculiarity.

Potato blight is a disease which is due to the growth of a parasitic fungus, the roots of which feed upon and destroy the tissue of the leaves. It first makes its appearance in the form of small dark spots and these gradually enlarge centrifugally, as the roots of

the parasite spread outward, until the whole of the leaf has been invaded, when it is almost black and dead. The excentral growth of the fungus gives rise to more or less circular spots and these are characterised by being marked with concentric rings of darker colour. After the death of the leaves the stems remain green for a little longer, but then die also. The fungus spreads from plant to plant by means of spores or seeds, and often it is but little more than a week from the time the disease is first seen until it has swept through and destroyed the vines over a large area.

With the appearance of the disease the growth of the tuber is affected and, as the leaves become more and more blighted, this gradually diminishes and stops, and except, indirectly, by cutting off its digestive system, the fungus does not attack the tuber.

Treatment.

The disease cannot be cured once it has seized upon a crop, but it can be held in check and often prevented by the timely application of fungicides, preferably Bordeaux Mixture.

POTATO BROWN ROT.

The Brown Rot of the Potato is not as yet a very serious disease in the Colony, but upon several occasions my attention has been drawn to it, where it had quite ruined the sets invaded and seriously depreciated the yield. The whole plant is affected, and the presence of the disease first recognised by the sudden wilting of the leaves followed by a collapse of the plant, the leaves turning brown and black. If a wilted plant is examined, the haulm will generally be found black and rotten at its base and the tubers more or less decayed. When the tubers are examined the sound looking ones, if cut, will be found discoloured within. The unsound tubers will generally be in all stages of decay, the rotten parts being soft and putrid.

This disease is not due to insects nor fungi, but is caused by a bacillus or germ which multiplies in the tissues of the plants and causes their breaking down. The germ is a very minute organism and related to the germs we know as causing epidemics and diseases of animals. The disease does not spread very much from plant to plant, but in America it has been noticed that biting insects, having fed upon diseased leaves and passing to sound plants, convey the disease with them.

Treatment.

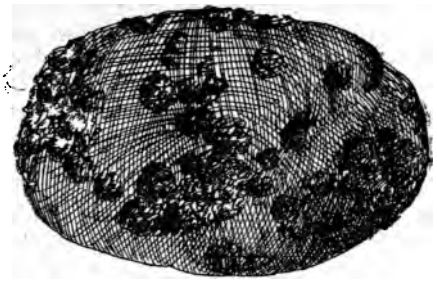
The diseased vines should be removed root, tuber and branch as early as noticed and burned. The crop should not be longer in the field than is necessary and care should be taken to secure good seed, for in the cases which have come under my notice there seemed little doubt but that the seed was diseased when planted. Should a field have suffered badly throughout it would be better not to put in potatoes again for some time, but sow some other crop.

POTATO SCAB.

Oospora scabies.

Potato Scab is not a particularly prevalent disease in the Colony, still most farmers are acquainted with the coarse scabby sores on

the tubers which the disease gives rise to. This scurvy roughness of the skin is due to the growth of a minute plant parasite or fungus, and its white mycelium or root-system is occasionally noticed upon freshly-dug potatoes. This fungus causes decay, which sets in beneath the scabs and often penetrates to some depth, doing a considerable amount of damage to certain sorts of potatoes. Some varieties are not so badly affected as others, the disease remaining more or less superficical, and only disfiguring the tuber. The presence of the disease is due in the first place to the planting of scabby seed, and a great deal of this is imported and planted. It has generally been found, too, that certain manures, such as kraal manure, favour its development, and there is very little doubt that the disease remains in the soil after a scabby crop has been removed, and that it will infect future crops.



Potato Scab.

It is advisable therefore not to plant in lands where the disease has been bad, and, further, diseased seed should be treated before planting. This is done by simply soaking it for one-and-a-half hours in a solution of corrosive sublimate, made by dissolving one ounce of the sublimate in nine gallons of water.

The use of formaline for this purpose also has its advocates, and the best results appear to be obtained by using eight fluid ounces of commercial formaldehyde to fifteen gallons of water. Some farmers have also found it advantageous to sprinkle the potatoes well with flowers of sulphur, and an authority upon the disease, as the result of his investigations, also gives sulphur as a remedy. His suggestion, however, is to sprinkle it in the open rows when planting, using it at the rate of 300 lbs. to the acre.

FOOT ROT OF THE ORANGE.

Foot Rot or Mal-di-goma of the orange is a very common disease among orange groves in this Colony. It is a disease which is confined to the crown and main roots of the tree, seldom extending very far up the trunk. In its ealiest stages the disease is indicated by an exudation of gum, and if the bark about this is examined the disease may be easily traced by the brown discolouration it causes. As the disease advances the bark dies and the tree attempts to recover by cutting off the diseased part. This is easily noticed where a dead piece of bark has fallen away and a new growth of the tissue can be seen. This action also takes place in the case of a boring beetle which affects a number of native trees and the weeping willow. The grub burrows in the bark above the wood and just below the outer cortex, here it forms a chamber some 4 inches square. When it leaves this as an adult the trees at once begin to grow a fresh covering of bark to replace that destroyed.

Orange trees affected with foot rot do not always die out at once, but they can generally be recognised by their sickly yellow appearance. The disorder is said to be due to a specific organism, but there are many conditions which have an important bearing upon it. First

among these I find a bad sub-soil and poor drainage, and where attention is paid to the latter, particularly as regards sub-drainage, the disease is seldom very troublesome. An important point also is the stock upon which the plant is grafted. Throughout Natal one finds a marked prejudice against grafted trees and in favour of seedlings. This, I feel sure, is wholly due to the immunity of the latter from foot-rot and the susceptibility of the former. Grafted trees in this country are usually upon rough lemon bottoms, and in Florida this is regarded as coming next to the bitter orange and pomelo (pomplemousse, etc.) in point of resistance, but it does not follow that this holds good here. The bitter orange has been much advocated as a stock, but owing to the slow growth of trees upon it, it is not much approved of as a stock either here or in the Cape. In consideration of the fact that our old seedling oranges do so well, I have been led to believe that instead of setting out seedling orchards these should be used as stocks. The pomplemousse also has much to recommend it as a stock, but I doubt if many have tried it.

I may mention that no treatment of the disease has been attempted, so far as I am concerned, but the following practice has been recommended:—Carefully remove the earth from around the tree and with a strong, sharp knife cut out the diseased tissue down to the healthy wood. Then paint the freshly cut wood with crude carbolic acid and water in equal parts or apply a quantity of lime around the tree and leave affected parts exposed.

LEMON SCAB.

Lemon Scab or Verrucosis is fast becoming very common, particularly in newly-planted orange groves, the disease being distributed from one or two nurseries upon large numbers of trees. The trouble is of a fungus nature and attacks leaves, twigs and fruit in a very characteristic manner, the affected parts becoming distorted and swollen and assuming a grey, corky nature of an unsightly and roughened appearance. The fruit is considerably disfigured and rendered unmarketable, whilst the functions of the leaves are interfered with to a marked degree. The disease attacks oranges and mandarins as well as lemons, but seldom to the same extent.

Treatment.

Sprayings with weak Bordeaux mixture or ammonia-carbonate of copper solution will both check the disease.

APPLE AND PEAR CANKER.

Canker of the apple and pear is a disease which, I regret to say, is becoming more prevalent in this country, even within the narrow limits of my experience. It is a disease due to the attack of certain fungi, for there appears to be more than one. One form of the disease has, to my knowledge, been in certain cases introduced upon English-grown plants and has proved most destructive. My first observation of this form of the disease was at Hilton Road, where a number of young trees were affected. In these the disease appeared in two phases. In the earlier stage circular spots of a mottled-brown colour were found from one inch and upwards from the ground, and in their growth there was a decided tendency to girdle the tree, and this often occurred where several had become confluent. Subsequent to the girdling the

upper part of the tree would succumb and then present the second phase, for the bark would shed away and leave the wood bare and dead. The diseased spots were usually marked with concentric rings, and when dead bark had died and was removed a replica of this ring was to be found upon the wood indicating that the fungus had attacked that whilst destroying the bark. An example of this disease was sent to Professor Galloway, and he favoured me with a reply to the effect that—

"The diseased apple twig had two species of fungus, each capable of causing the injury. One was a species of *Pestallozia*, while the other was *Phoma mali*. The latter will probably prove to be the more destructive, although the peculiar habit that the former has of "ringing" the twigs also causes it to be destructive. This could probably be prevented by the use of Bordeaux Mixture."

The second form of canker to which I refer is noticed usually upon old, well-grown trees. Apples, in particular, are affected, and I have seen it upon oak and willow as well. In this form the disease may break out anywhere upon the limbs or upper portions of the trunk, and it does its mischief very rapidly. In one case under observation an apple limb two inches in diameter was affected in the spring. It produced flowers, foliage and fruit, but collapsed in three or four days, a month or so later, the green leaves turning suddenly brown and the partly-grown fruit shrivelling. Where larger limbs are affected the disease does not always succeed in girdling in so short a time, but large areas of bark die and break partly away presenting a much-roughened appearance,

Characteristic of this form of canker are the numerous pink pustules which break out over the infected area and which are often so numerous and closely associated as to appear quite a distance off as whitish-pink patches. Indeed, upon the dark bark of the oak I have been able to make them out when from 20 to 30 feet from the ground. Portions of limbs suffering from this disease were also submitted to Professor Galloway, who writes:

"The grey fungus tinged with pink and covering a considerable portion of the surface, is a species of *Corticum* and probably does no injury, as all species of *Corticum* are supposed to be saprohytic. Besides this fungus there is another forming small orange-coloured cushions from 2-5 millimetres in diameter and 1 or 2 in height. These are apparently some stage of *Nectria* or some related genus, although this cannot be exactly determined. One or two species of *Nectria* are known in this country and Europe to cause a disease of the apple known as canker which resembles very much the disease upon the specimens sent.

Treatment.

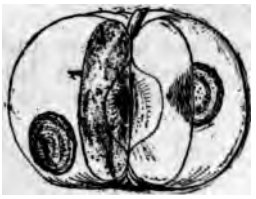
The affected parts should be removed as much as possible and destroyed by fire. Winter sprayings or dressings with lime sulphur salt wash and summer spraying with Bordeaux mixture are suggested.

APPLE BLACK SPOT.

Glæosporium versicolor, B and C.

This disease is variously known as "Bitter Rot," Ripe Rot, and Black Spot, and is a fungus which I have onlv noticed on several varieties of apples locally. It usually appears upon the fruit when turning to ripeness and is quite capable of ruining the whole of the

fruit upon the tree. It commences as a small round black spot and this enlarges centrifugally until it reaches a considerable size, from that of a sixpenny to a shilling-piece and larger. This spot assumes various shades of brown and is marked by a series of concentric rings from which spring pustules of spores or seed. When ripe these pustules burst and hundreds of thousands of reddish spores are liberated and form fresh centres of disease or rest over until the following season.



Apple Black Spot.

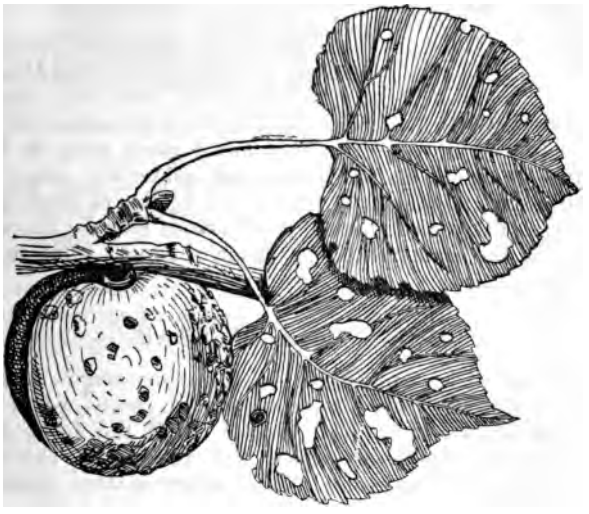
TREATMENT.

Allow no diseased fruit to fall or rot upon the ground but gather it and feed to the pigs or else destroy effectually, otherwise next year's crop is certain to become affected. Having gathered the diseased crop one season make preparations to spray during the next, using ammonia-carbonate of copper solution. Three sprayings of this at intervals of 10 to 14 days should be made as soon as the fruit shows signs of ripening.

SHOT-HOLE FUNGUS.

Phyllosticta circumcissa.

This is a well-known fungus disease of the peach, nectarine, plum, cherry and apricot. It derives its name from the shot-riddled appearance it causes the leaves of these fruits to assume. It attacks the fruit as well, and apricots in particular suffer from it, acquiring a very scabby and unsaleable appearance and the size



Shot Hole Fungus.

usually being much affected. The disease first makes its appearance upon the foliage in the form of small circular spots of a reddish-brown colour. These spots represent the area which the fungus has destroyed, and, as it soon dries out when the tissue is dead, these

pieces fall out and leave "shot-holes." The affected foliage generally drops from weakness and the fruit does not reach maturity.

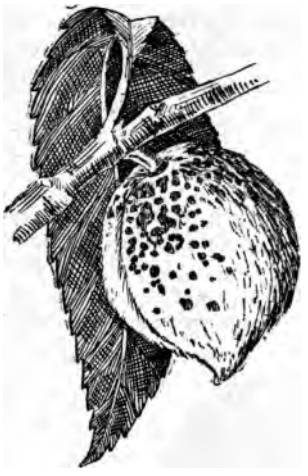
TREATMENT.

As soon as the leaves appear, spray with Bordeaux mixture and repeat the spraying at intervals of two or three weeks up till Christmas, using two to four sprayings in accordance with the severity of the attack.

BLACK SPOT OF PEACH.

Cladosporium carpophilum, Thm.

This disease is of a fungus nature and has but recently made its appearance in Natal, having been imported from North America upon peaches and apricots, both of which fruits suffer a good deal from it in such orchards as it has been introduced into. The disease is noticed chiefly upon the fruits, and makes its appearance very often whilst these are yet young, in the form of black or brown specks. These enlarge until about $\frac{1}{8}$ inch in diameter and are usually situated upon the one side of the fruit, and although the spots themselves are small, seldom being more than $\frac{1}{8}$ inch, they at last become so numerous that they run together and form a large diseased area. Beneath this the growth is checked and very often the fruit cracks.



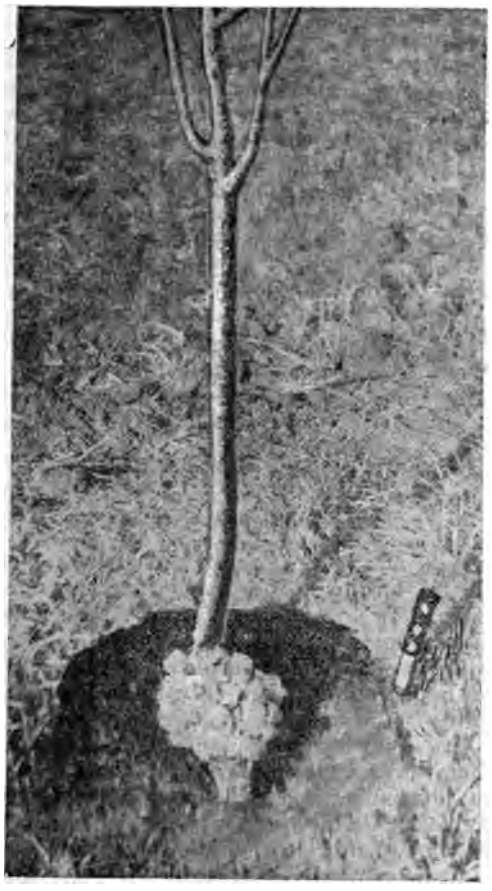
Black Spot of Peach.

TREATMENT.

The only treatment which I can at present recommend for this disease is such as is adopted in America. This consists of a spraying with Bordeaux mixture after the fruit has formed, early in November. The mixture being prepared from good materials using 1 lb. of copper-sulphate to 10 gallons of water and 1-1¼ lbs. of fresh quick-lime. A month later one or two further applications may be necessary, and for this purpose the ammoniacal-carbonate of copper solution (see page 29) should be applied.

CROWN GALL OF PEAR.

This disease, which appears to be of fungus origin, has made its appearance in Keiffer pears imported within recent years from the United States of America. The disease takes the form of a huge gall-growth, which developes upon the crown of the tree just below the surface of the ground. The effect of this growth, which sometimes assumes very large proportions (see illustration), is to first stunt or dwarf the tree and subsequently to kill it. This is partly due to the gall absorbing the nourishment supplied by the roots which should, under ordinary circumstances, go upwards for the development of limbs, branches and foliage. The death of the tree is more than probably due to the entrance of fungi and other parasites into the more susceptible tissue of the gall.



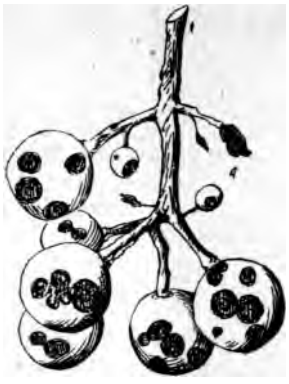
Crown Gall of the Pear.

Investigations in Arizona, U.S.A., have shown that Crown Gall is of a contagious character. The same studies indicated that copper-sulphate (bluestone) is the best substance to apply for the prevention of the disease. It is recommended to mix a given weight of ground bluestone with twice its weight of lime and with water bring the mixture to the consistency of paste. This should be applied to the wounds after the galls have been cut off, and these should be gathered and burnt.

ANTHRACNOSE OF THE GRAPE.

Sphaceloma ampelinum, Sace.

Anthracnose or black spot is one of the most serious diseases affecting the grape in this Colony. It attacks the leaves, the new growth and the berries with equal virulence. It appears in the form of black spots which are circular in outline and which increase in size until they are are $\frac{1}{4}$ to $\frac{1}{2}$ an inch in diameter. As the spots enlarge the centres assume a grey colour, and the attack upon the berry is very characteristic.



Anthracnose of the Grape.

TREATMENT.

After pruning burn all cuttings and such dead leaves as are found about. Rub off the rough bark and swab at once all parts of the vine thoroughly with a solution of sulphate of iron and sulphuric acid. To prepare this take 20 gallons of water, heat it and dissolve as much sulphate of iron (green vitrol) as it will take up, then add 16 fluid ounces of sulphuric acid. Great care must be taken in using this as it is caustic, and will destroy machinery and clothes. Follow this treatment by spraying with Bordeaux mixture once every two or three weeks, commencing before the vines blossom.

STRAWBERRY-LEAF BLIGHT.

Sphærella fragaræ, Tal.

This disease is not of uncommon occurrence where strawberries are grown in Natal, but up to the present I have not noticed it doing the serious mischief it is capable of. The disease takes the form of more or less circular spots upon the leaves from $\frac{1}{8}$in. to $\frac{1}{4}$in. in diameter. These, when young, are a decided purple colour, but as they enlarge the central portion become quite light, only the edge of the spot remaining purple. This is the only disease of any importance which I have yet met with here amongst these plants, but during last year Messrs. Hosking Brothers sent me specimens of leaves from their plots the stems of which were covered with conspicuous fungus growth. This was submitted to Professor Galloway, of the U.S. Department of Agriculture, from whom I subsequently learned that it was a fungus known as *Diachea leucopoda*, a saphrophyte living in its plasmodial stage in the soil and, when ready to fruit, creeping up various plants and fruiting. It does no harm to the plants except such as comes from the possible exclusion of air from the stomata.

TREATMENT.

Spraying several times with Bordeaux mixture. Cut and burn leaves after gathering fruit.

PUMPKIN-LEAF MOULD.

Oïdium erysiphoides.

This fungus is of common occurrence at certain times amongst pumpkin vines, and it also attacks melons, squashes, etc. It is easily recognised by the amount of white powdery-matter found upon the under-surfaces of the leaves. The fungus is of a superficial nature, sending its roots or hyphæ over the surface of the leaves and forming a white mat upon which grows the powdery mass of spores which characterise it.

TREATMENT.

Burn infested vines and do not plant again in the same situation if possible for a season. Carefully spray under-surfaces with Bordeaux

xture or dust, with the aid of dusting bellows, with flowers of sulphur ring the middle of a warm day.

OTHER FUNGUS DISEASES.

Among the fungus diseases, of perhaps less importance than the regoing, mention may be made of the following which have come ıder observation. Their determination is, however, only pro- sional.

Grape Mildews—*Plasmopara viticola* and *Uncinula spiralis.*

Orange-leaf Black Spot.—*Calletotrichum adustum.*

Peach and Plum Rust.—*Puccinia pruni.*

Mango Black Blight.—*Pestalozzia uvicola.* (This disease is looked ›on locally as a natural feature of certain mangoes and indicative sweetness.)

Mango-leaf Fungus.—*Strigula feei.*

Tomato Blight.—*Macrosporium solani.* (This is the same disease Early Potato Blight.

Bean and Cowpea Rust—*Uromyces phaseoli.*

Maize Rust.—*Puccinia sorghi.*

Maize Smut.—*Ustilago maydis.*

Oat Smut—*Ustilago avenae.*

Sugar-cane Smut.

Rose Mildew.—*Sphaerotheca pannosa.*

Rose Rust.—*Phragmidium subcorticatum.*

Rose, Black Leaf-spot.—*Cercospora rosaecola.*

Wild Raspberry Rust.

Chrysanthemum-leaf Disease.—? *Macrosporium*, sp.

Violet Disease.—*Cercospora violae.*

❋ ❋ ❋

APPENDIX A.

No. 37, 1900.

WALTER HELY-HUTCHINSON,
Governor.

PROCLAMATION,

By His Excellency the Honourable SIR WALTER FRANCIS HELY-HUTCHINSON, Knight Grand Cross of the Most Distinguished Order of Saint Michael and Saint George, Governor and Commander-in-Chief in and over the Colony of Natal, Vice-Admiral of the same, and Supreme Chief over the Native Population.

Whereas by Proclamation No. 11, bearing date the 16th day of June, 1890, the Governor, acting with the advice of the Executive Council, did, in pursuance of the provisions of Law No. 15, 1881, prohibit the introduction into this Colony of all plants or cuttings of Grape Vine, or portions of such plants or cuttings, from the Colony of the Cape of Good Hope:

And whereas it is expedient to revoke the said Proclamation, and to makes rules for regulating the introduction of plants and of any parts of plants which may be diseased or likely to bring disease into this Colony:

Now, therefore, in pursuance of the powers vested in me by Law No. 15, of 1881, I do hereby, with the advice of the Executive Cuncil, proclaim and make known as follows:—

2. The above-recited Proclamation, No. 11, of 1890, is hereby revoked.

2. The rules forming the Schedule of this Prclamation, and made under the provisions of Section 2, of Law No. 15, of 1881, shall be in force from the date of the promulgation of this Proclamation in the "Natal Government Gazette."

3. Any person willfully contravening any of the said rules shall be liable to a penalty not exceeding Twenty Pounds, and, in default of the payment thereof, to imprisonment, with or without hard labour, for any term not exceeding six weeks, unless such penalty be sooner paid.

GOD SAVE THE QUEEN!

Given under my hand and the Public Seal of the Colony, at Government House, Pietermaritzburg, Natal, this Second day of June, One Thousand Nine Hundred.

CHARLES J. SMYTHE,
Colonial Secretary.

RULES MADE UNDER SECTION 2, OF LAW No. 15, 1881.

Conditions for the Importation of Grape Vines, Cuttings and the like, and of other Trees, Plants, Fruits, and the like.

1. The importation of all Grape Vines, cuttings, grafts, or foliage thereof is prohibited unless imported by the Department of Agriculture.

2. All trees and plants, other than vines, and all parts thereof, and all fruit of any description, and all tubers, roots, bulbs, or portions thereof, and all packages, cases, pots, or coverings whatsoever, containing such, shall, before being introduced into this Colony from places beyond the boundaries thereof, undergo a strict examination by competent officer appointed for that purpose, to determine as far as

possible the absence of noxious insects and plant diseases which it would be prejudicial to this Colony to allow to be introduced; and it shall be the duty of the consignee to open all such packages, cases or coverings, for the purpose of the examination aforesaid, and to afford every facility to the said Examining Officer during his examination.

3. On the aforesaid Officer being satisfied as to the absence of noxious insects and plant diseases in such trees, plants, fruits, tubers, roots, bulbs, or portions thereof, and their packages, cases, pots or coverings, he shall give a certificate to that effect to the consignee; and without such certificate no such articles shall be permitted to enter the Colony.

4. All trees, plants, fruits, tubers, roots, bulbs, or portions thereof, or the packages, cases, pots, or coverings in which they may be packed, which shall be found to be infected with any noxious insect or plant disease, shall be cleansed or disinfected by the consignees in the manner prescribed by, and to the satisfaction of, the Examining Officer, and if it is not so cleansed or disinfected, or if such disinfection shall be deemed or found to be ineffectual, shall be immediately destroyed.

5. The importation into this Colony of any stone-fruit tree, or of any portion thereof whatever, from the United States of America or the Dominion of Canada is prohibited, unless such importation be accompanied by a sworn declaration stating the trees, or portions thereof, as the case may be, are not from areas where either of the diseases known as peach yellows and peach rosette exist or have existed, nor that such trees, or portions thereof, were grown or produced from seed grown in lands, or adjacent to lands, in which either diseases mentioned exists or has existed.

6. Subject to the foregoing regulations stone-fruit trees, and all portions thereof, may be imported into the Colony, provided that such consignment of trees, or portions thereof, be accompanied by a sworn declaration from the consignor that the articles proposed to be imported were not grown in the United States of America or in the Dominion of Canada, and without such declaration no such articles shall be permitted to enter the Colony.

7. On the Examining Officer being satisfied as to the sufficiency of the declaration in Section 6 above mentioned, he shall give a certificate to that effect to the consignee, and without such certificate no such article shall be permitted to enter the Colony.

8. The Government does not hold itself responsible for any loss or damage that may result from the destruction of the articles under the provisions of these regulations, or from any process that may be considered necessary to cleanse or disinfect the articles or to discover the existence or otherwise of any noxious insect or plant disease.

9. No charge will be made for the examination of consignments but the importer will, in every case, be charged with the actual cost of treatment.

10. These regulations shall not apply to canned or preserved fruits.

11. For the purpose of these regulations the Port of Durban will be regarded as the one port of entry for all fruit trees, plants, or portions thereof.

12. These regulations will not apply to consignments which it can be proved to the satisfaction of the Department of Agriculture were on order on the date upon which these regulations were promulgated.

No. 15, 1881.

(Signed) EVELYN WOOD,
Major-General,
Administrator.

LAW No. 15, 1881.

(Enacted by the Administrator of the Government of the Colony of Natal, with the advice and consent of the Legislative Council thereof).

" To Regulate the introduction into this Colony of Plants or Cuttings which, by reason of Disease, or otherwise, might be injurious to the interests thereof."

Whereas it is expedient to prohibit, or to regulate under certain conditions, the introduction into this Colony of any Plants or Cuttings which are either affected with some disease which it would be prejudicial to this Colony to be allowed to be introduced, or come from places where any such disease affecting them exists, or is supposed to exist:

Be it therefore enacted by the Administrator of the Government of Natal, with the advice and consent of the Legislative Council thereof, as follows:—

1. It shall and may be lawful for the Governor, from time to time, and at any time by and with the advice of the Executive Council, to prohibit absolutely the introduction into this Colony of any Plants or Cuttings, which are either actually affected with some disease which it would be prejudicial to this Colony to be introduced, or which come from places where any such disease exists, or is supposed to exist. Such prohibition shall be published by Proclamation in the " Natal Government Gazette." From and after the publication of any such Proclamation any person who shall introduce into this Colony any of the articles or things, the introduction of which is prohibited in such Proclamation, shall be liable to a penalty not exceeding Twenty Pounds, or, in default of payment thereof, to imprisonment, with or without hard labour, for any term not exceeding Six Weeks, unless such penalty be sooner paid.

2. The Governor may, from time to time, and at any time, with the advice of the Executive Council, frame and issue, by Proclamation in the "Natal Government Gazette," such Rules and Regulations as he may deem necessary, concerning the introduction of any such articles or things as in the preceding section mentioned.

3. It shall and may be lawful for the Governor in Council, from time to time, to revoke, alter, or vary any such Proclamation as aforesaid; and also, in and by any such Proclamation, as aforesaid, to provide that any person wilfully contravening the Rules and Regulations so published, shall be liable to a penalty not exceeding Twenty Pounds, and, in default of payment thereof, to imprisonment, with or without hard labour, for any term not exceeding Six Weeks, unless such penalty be sooner paid.

4. All contraventions of the provisions of any such Proclamation, as aforesaid, shall be prosecuted by or at the instance of the Attorney-General, at the suit of the Queen, in the usual manner, before the Supreme Court or any Circuit Court, or by a Clerk of the Peace before a Magistrate's Court.

5. All fines imposed by this Law, or by any Proclamation issued thereunder, shall be paid to Her Majesty the Queen, Her Heirs and

Successors, for the public uses of the Colony: Provided that the Court may, in any case, award to be paid any portion, not exceeding one-half, to any person who shall have given such information as shall have led to the detection or conviction of the offender in such case.

6. This Law shall commence and take effect from and after the date of the promulgation thereof in the "Natal Government Gazette."

Given at Government House, Natal, this Twentieth day of December, 1881.

By command of His Excellency
the Administrator of the Government,
(Signed) C. B. H. MITCHELL,
Colonial Secretary.

APPENDIX C.

No. 11, 1890.

C. B. H. MITCHELL,
Governor.

PROCLAMATION,

By His Excellency SIR CHARLES BULLEN HUGH MITCHELL, Knight Commander of the Most Distinguished Order of Saint Michael and St. George, Governor and Commander-in-Chief in and over the Colony of Natal, Vice-Admiral of the same, and Supreme Chief over the Native Population.

Whereas by Law No. 15, 1881, entituled Law "To regulate the introduction into this Colony of Plants or Cuttings which by reason of Disease or otherwise might be injurious to the interests thereof," it is enacted that it shall and may be lawful for the Governor, from time to time, and at any time, by and with the advice of the Executive Council, to prohibit absolutely the introduction into this Colony of any Plants or Cuttings which are either actually affected with some disease, the introduction of which would be prejudicial to this Colony, or come from places where any such disease exists, or is supposed to exist:

And whereas information has been received of the existence in the Colony of the Cape of Good Hope of the disease among grape vines known as "Phylloxera":

And whereas it has appeared expedient to prohibit, under the provisions of the above recited Law, the importation of all Plants or Cuttings of the Grape Vine from the aforesaid Colony of the Cape of Good Hope:

Now, therefore, I, by virture of the powers vested in me by the said Law No. 15, 1881, do, by and with the advice of the Executive Council, absolutely prohibit the introduction into this Colony of all Plants or Cuttings of the Grape Vine, or portions of such Plants or Cuttings, from the Colony of the Cape of Good Hope aforesaid.

GOD SAVE THE QUEEN!

Given under my hand and the Public Seal of the Colony, at Government House, Pietermaritzburg, this Sixteenth day of June, One Thousand Eight Hundred and Ninety.

By His Excellency's command,

A. H. HIME,
Acting Colonial Secretary.

APPENDIX D.

No. 41, 1894.

WALTER HELY-HUTCHINSON,
Governor.

PROCLAMATION,

By His Excellency the Honourable SIR WALTER FRANCIS HELY-HUTCHINSON, Knight Grand Cross of the Most Distinguished Order of Saint Michael and Saint George, Governor and Commander-in-Chief in and over the Colony of Natal, Vice-Admiral of the same, and Supreme Chief over the Native Population.

Whereas by Law No. 15, 1881, entituled Law "To regulate the introduction into this Colony of Plants or Cuttings which by reason of Disease or otherwise might be injurious to the interests thereof," it is enacted that it shall and may be lawful for the Governor, from time to time, and at any time, by and with the advice of the Executive Council, to prohibit absolutely the introduction into this Colony of any Plants or Cuttings which are either actually affected with some disease which it would be prejudicial to this Colony to be introduced, or which come from places where any such disease exists, or is supposed to exist:

And whereas information has been received of the existence in the Island of Mauritius of disease among Sugar Cane:

And whereas it has appeared expedient to prohibit, under the provisions of the above recited Law, the importation of all Plants or Cuttings of Sugar Cane from the aforesaid Island of Mauritius:

Now, therefore, I, by virtue of the powers vested in me by the said Law No. 15, 1881, do, by and with the advice of the Executive Council, absolutely prohibit the introduction into this Colony of all Plants or Cuttings of Sugar Cane, or portions of such Plants or Cuttings, from the Island of Mauritius aforesaid.

GOD SAVE THE QUEEN!

Given under my hand and the Public Seal of the Colony, at Government House, Pietermaritzburg, Natal, this Twenty-fourth day of September, One Thousand Eight Hundred and Ninety-four.

JOHN ROBINSON,
Colonial Secretary.

APPENDIX E.

No. 79, 1897.

WALTER HELY-HUTCHINSON,
Governor.

PROCLAMATION,

By His Excellency the Honourable SIR WALTER FRANCIS HELY-HUTCHINSON, Knight Grand Cross of the Most Distinguished Order of Saint Michael and Saint George, Governor and Commander-in-Chief in and over the Colony of Natal, Vice-Admiral of the same, and Supreme Chief over the Native Population.

Whereas by Law No. 15, 1881, entituled Law "To regulate the introduction into this Colony of Plants or Cuttings which, by reason of Disease or otherwise, might be injurious to the interests thereof," it is enacted that it shall and may be lawful for the Governor, from time to time, and at any time by and with the advice of the Executive Council, to prohibit absolutely, the introduction into this Colony

of any Plants or Cuttings which are either actually affected with some disease which it would be prejudicial to this Colony to be introduced, or which come from places where any such disease exists, or is supposed to exist:

And whereas information has been received of the existence in the island of Madeira, of a disease among apples known as the Codling Moth:

Now, therefore, I, by virtue of the powers vested in me by the said Law No. 15, 1881, do, by and with the advice of the Executive Council, absolutely prohibit the introduction into this Colony of all Plants, Portions of Plants, Cuttings, or anything taken off, or from apple trees from the Island of Madeira aforesaid.

GOD SAVE THE QUEEN!

Given under my hand and the Public Seal of the Colony, at Government House, Pietermaritzburg, Natal, this Fifteenth day of September, One Thousand Eight Hundred and Ninety-seven.

THOS. K. MURRAY,
Colonial Secretary

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NATAL.

DEPARTMENT OF AGRICULTURE.

SECOND REPORT

OF THE

GOVERNMENT ENTOMOLOGIST.

1904.

NATAL.

DEPARTMENT OF AGRICULTURE.

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1901.

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Office of the Government Entomologist,
Pietermaritzburg, Natal,
January 25th, 1901.

LETTER OF SUBMITTAL.

The Honourable Minister of Agriculture,

I have the honour to present herewith my report for the year 1901.

Compared with my first report, presented under date of 16th May, 1901, this is naturally of small dimensions; only a few insect pests and plant diseases which did not find a place in my former report being reported upon in detail.

Beyond the discussion of these, the present report only includes a review of the work of the year and general observations relative to pests and plant diseases.

Respectfully submitted,

CLAUDE FULLER,
Entomologist.

Personal.

The appointment of an Entomologist to the Department of Agriculture followed upon a resolution passed at the Annual Meeting of the Natal Farmers' Conference, April, 1897, when it was resolved (Resolution 3) to approach the Government with a view to obtaining the services of such an expert.

A longer appointment than for a term of three years was not contemplated* by the Government, and it was upon this understanding that I commenced my duties early in August, 1899.

The term, for which my agreement was made, will consequently expire shortly after the presentation of this report. As this may, therefore, be the last and only opportunity which I may have for so doing, I now thank the very large number of farmers and others for the encouragement given me by their spontaneous appreciation of my first report. Some have questioned the advisability of my having dealt in my first report with so many different subjects; but, in doing so, I would explain that I had to bear in mind the all too brief time there was before me in which to place at the disposal of the farmers and planters of this colony such knowledge as I possessed of the various pests and diseases prevalent in Natal. Despite its many deficiencies, it will, I believe, serve the purpose for which it was intended; and the notes herein contained may be considered as a supplement.

In the commencement of my former report, I took occasion to tender my acknowledgments of a number of favours received from various friends and correspondents. Of these, Miss E. A. Ormerod, one of the kindliest, has since passed away; and, so far as concerns the other kind friends, my debt of gratitude is greater than it was a twelvemonth ago. Furthermore, I am indebted for favours to many others, and would especially make mention of Professor T. D. A. Cockerell, State Entomologist of New Mexico, who kindly worked out a number of scale insects which I had collected. I have

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* See Annual Report of the Commissioner of Agriculture for the year 1898.

also to thank Mr. G. C. Williams, Mr. E. T. Mullens, and Mr. T. St. George, of Pietermaritzburg, for almost daily contributions to my cabinets.

These little collections of insects, arriving thus at short intervals of time, are of great interest and value, though they may, for the greater part, consist of the most common forms. Their principal value to me lies in the fact that they supplement my own observations with regard to the seasonal appearance of the various insects and, as often, anticipate them. Indeed, no one but a specialist working at economic entomology can fully appreciate the great help it is to have specimens, of any sort, sent in occasionally from different parts of a country.

Itinerary.

No general tour of any part of the colony has, as yet, been attempted; though I hope to visit some of the outlying districts in 1902. A number of visits, forty-eight in all, and covering about eighty-six days, have, however, been paid to various places and farms. Of these the following are instanced, in chronological order, as illustrations:

7th January.—W. Pepworth, Esq., M.L.A., Lidgetton: an inspection of a blighted potato-field and pest-ridden calf-stable.

8th and 21st January.—Messrs. Hutchinson Bros., Balgowan: experiments in spraying of potatoes with Bordeaux Mixture. (See page 8 of my first report.)

22nd January.—W. Pepworth, Esq., M.L.A., Lidgetton: experimental spraying of potatoes with "Strawsonite."

23rd January.—F. F. Churchill, Esq., M.L.A., Hill Crest: examination of orchard, by request; advice tendered upon treatment of various diseases and the pruning of trees.

19th February.—Hon. Thomas Kirkman, M.L.C., Umzinto: by request, observations made upon coffee diseases and fruit-moth attack.

1st March.—G. Armstrong, Esq., M.L.A.: instructions given for the fumigation of citrus trees.

13th March.—Ladysmith: by request, attended meeting of the Klip River Farmers' Association, and visited Messrs. Pepworth & Reid's farm, "Reitfontein."

15th March.—T. W. Hall, Esq., Mooi River: examination of a blighted mealie-field. Upon examination the disease proved to be *Helminthosporium turcicum*. (See page 133, 1st report.)

6th April.—W. Pepworth, Esq., M.L.A., Lidgetton: an examination of a field attacked by a new form of potato-blight, which, upon examination, proved to be the well-known potato murrain of Great Britain; see further notes on pages 51-2.

8th May.—H. W. James, Esq., Zwolle, Verulam: inspected new sugar-cane imported by the Department of Agriculture.

21st May.—H. Blaker, Southdowns, Estcourt: inspected field of blighted turnips and cabbages.

11th June.—W. R. Hindson, Nonoti Peak, Kearnsey: under instructions.

10th July.—Richmond Agricultural Society's Show: attended at the request of the President. Two cases of insects of economic interest exhibited.

7th August.—W. McFie, Esq., Town Bush Valley: demonstration of spraying of citrus trees, etc.

21st August.—Messrs. M. F. Phipson and W. Oldfield, Fox Hill: examination of Mapstone oat crop.

11th September.—Attended meeting of New Hanover Farmers' Association, by arrangement with Secretary.

23rd September.—J. Baynes, Esq., M.L.A., Nel's Rust, and G. Alexander, Meyers Hoek: demonstration in pruning young deciduous fruit-trees.

4th October.—D. Brown, Esq., Darnal: general inspection; visited at suggestion of W. C. Robbins, Esq. Observations made upon coffee borer,

5th October.—T. G. Colenbrander, Esq., New Guelderland: by arrangement, general inspection of orchard, etc.

23rd October.—E. B. Griffin, Esq., Willow Grange: inspection of Mapstone oat crop, etc., under instructions.

30th November.—C. B. Lloyd, Esq., Highlands: inspection of Mapstone oat crop, etc., by request.

10th December.—Messrs. Townshend Bros., Sea-Cow Lake: examination of diseased "Poonah" sugar-cane; see further notes, pages 42-7.

12th December.—W. Starr, Esq., Verulam: general observations upon cutworms, fruit-moth attack, etc.

Three endeavours were made to address meetings of farmers. Lectures, under the auspices of Agricultural Associations, by specialists attached to Departments of Agriculture, are, in many colonies, regarded as one of the best means of disseminating information. I had arranged, during the year, to deliver lectures in the country upon three occasions, but the results have not been very encouraging. On 13th March, at the suggestion of Mr. Walter Pepworth, M.L.A., I attended two meetings of farmers at Ladysmith. Mr. Pepworth kindly introduced me to the meetings, and explained the object I had in view in attending, but owing to the heavy pressure of other business, the farmers assembled had not time to hear me. Later on, I approached the Secretary of the New Hanover Farmers' Association, with a view of attending a meeting and getting into touch with the farmers of that district. At the invitation of the Secretary, I was present at the annual meeting of the Association. In this instance also other business prevented the hearing of my address. My third effort entailed a trip to Umzinto, at the invitation of the Agricultural Farmers' Association. This meeting was specially arranged for, and I was particularly asked to give a lecture upon the treatment of citrus pests and of citrus trees. To be brief, two individuals turned up at the meeting—the President of the Association and myself.

Whilst upon the subject, I should also like to make a few remarks regarding the attendance of Departmental specialists at Agricultural Shows. I would not do so but for so much comment having been passed during the last twelve months upon the absence of "experts" at these gatherings, and for the fact that such comment virtually amounts to a censure upon the Dairy Expert and myself, we being the only agricultural "experts" attached to the Department. Since coming to Natal, I have received

and accepted two invitations to Agricultural Shows, but I am decidedly opposed to the contention that all the specialists of the Department should attend every show, unless their services be specially required. As time progresses, it will, of course, be necessary for the Department of Agriculture to be represented in some way at each, but not necessarily by the attendance of every officer.

Correspondence, Publications, etc.

The correspondence of this branch of the Department for 1901 amounts to 578 letters received, and 572 despatched, both exceeding the figures for the 17 months prior to 31st December, 1900. I am pleased to be able to add that there is a gratifying change in the nature of the correspondence, there being more enquiries for information and advice than formerly.

There has been no marked increase during the past twelvemonths in the number of my contributions to the *Agricultural Journal*, owing chiefly to the fact that the greater part of my spare time, out of office hours, has been absorbed in the preparation and publication of the report for 1899-1900. However, a number of items, in the form of articles, notes, compilations and selections, were published, of which the following are instanced :—

Title.	Form.	Volume and Page.
Potato Diseases (Scab, Rot and Moth)	Article(Illustrated)	Vol. III., 681.
Fruit Moth *(O lienardi)* ...	Note	„ 706.
Entomology at the Cape ...	Review	„ 739.
Locust Destruction by Mr. Robbins	Note	Vol. IV., 21.
Mealie Blight *(Helminthosporium turcicum)*	Note	„ 34.
Some Winter Reminders ...	Illustrated Notes...	„ 261.
Entomology at the Cape ...	Review	„ 441.
The Colorado Beetle ...	Note	„ 513.
The Black Peach Aphis ...	Article(Illustrated)	„ 564.
Peach Leaf-curl	„ „	„ 624.
Mapstone Oats	Reports and Notes	„ 629.
Maggot Fly, Myiasis ...	Note	„ 656.

Office Work.

Though occupying the greater portion of my time, there is little to particularize in detail under this heading beyond what is given in the separate heading of correspondence and publications. However, a considerable amount of time has been taken up in the preparation and examination of material. A large amount of official matter, in various connections, has also received my attention, and a number of studies in plant diseases and the life-histories of various insect pests have been continued. Coming directly under this heading is the drafting of a Bill, entitled "Insect Pests and Plant Diseases Bill." This has been prepared to meet the resolution (No. 22) carried at the Eleventh Annual General Meeting of the Natal Farmers' Conference, 16th April, 1901.

The measure which I have outlined has, apparently, a wider scope than that embraced by the resolution mentioned above. The objection, however, disappears when the whole resolution is considered, for it demands a measure which will prevent the "distribution of diseased or insect-pest infested trees and plants," and, to prevent such, a measure of very general application is necessary.

The main features of the Bill, are (1) the powers which it confers to deal with fruits, plants, etc., imported from abroad; (2) the authority for the examination and treatment of their produce; (3) the powers conferred for the control and eradication of any insect pest or plant disease within the colony, and (4) the appointment of a Board of Advice.

With regard to the first of these, provision is already made by Proclamation No. 37, 1900, under Law No. 15, 1881, but it appears desirable that these powers should be more explicitly defined, as in section five, sub-sections A and B of the draft measure.

The various powers conferred by the Bill for the periodical examination of nurseries and the authority to quarantine them, if necessary; together with the compulsory fumigation of fruit trees and shrubs immediately prior to delivery, are only such as are required to make a measure of this sort efficacious.

The clauses dealing with the more general control of insect pests and plant diseases throughout the Colony are intended to give power to suppress any outbreak which may occur of any pernicious pest or disease which may not be established in the Colony, and which may have been declared an "insect pest" or "plant disease" within the meaning of the Bill.

The "Board of Advice," for the appointment of which provision is made, is a feature of the measure which ought to recommend itself to the agricultural community generally, for it will place to no inconsiderable extent the working of the proposed measure (should it find a place upon the Statute Book) in the hands of that section of the public.

I am well aware that, in drafting these proposals, I have exceeded the intention of the resolution of the Farmers' Conference, which was aimed at the nurseryman alone. It is for this reason that I have not presented this draft measure in a regular form to the head of the Department. This course I have taken in order that I might appeal to the common sense of nurserymen, planters, and agriculturists through the medium of this report as to the necessity and justice of some such measure. I would point out that similar enactments are in force in nearly all the United States of N. America, in many states of the Dominion of Canada, and in all the states of the Commonwealth of Australia; and I would add that these acts for the suppression of insect pests and plant diseases were not brought into force until many more foreign troubles had been introduced and established in those countries than are to be found in Natal to-day.

Port Examinations under Proclamation No. 37, 1900.

These have been conducted in a very efficient manner by Mr. C. B. Jones, Surveyor of Customs, who has taken a great interest in this work. Monthly statements have been supplied regularly by Mr. Jones, and these have appeared from time to time in the *Agricultural Journal.* Apart from other considerations, the returns are interesting, because they furnish an index of the quantities of

plants, fruits, etc., imported into the Colony ; statistic formerly unobtainable. The following returns are collate from Mr. Jones' monthly statements :—

Ornamental Plants	... ...	54 cases
Do. do.	... ...	270 plants
Fruit Trees	... ...	24 cases
Do. do.	... ...	4,000 plants
Oranges	... ...	347 cases
Lemons	... ...	1,456 „
Grapes	... ...	1,050 „
Grape Vines	... ...	2 „
Peaches	... ...	347 „
Apples	... ...	9,179 „
Pears	... ...	1,367 „
Plums	... ...	441 „

A general résumé has been furnished by Mr. Jone and appears in the Departmental Report for the yea It is satisfactory to state that little of a serious natur with regard to insect pests, has come under observatio and Mr Jones' remark concerning the general improv ment to be noticed in the particular lines imported worthy of consideration. Aphides are more generall observed than any other pest; the Mussel Scale (*Myti aspis citri*) and the Black Citrus Scale (*Parlatoria zizyph* Lucas) come next.

No doubt, however, large numbers of minute insec will escape detection in examination, and, in order t avoid this possibility, all large consignments are no fumigated. In future I hope to have all living plan treated.

GENERAL MATTERS.

Of general interest, and marking a progressive ste has been the formation of the "Natal Fruit Farmer Union," with its headquarters at Durban. Upon comin to Natal nothing struck me more forcibly than the enti absence of a Fruit-growers' Association of any sort, an it has been a great pleasure to me to see this Unio formed, because such an institution is essential to t best interests and advancement of fruit culture.

The present Union, I am told, was the outcome of a meeting initiated by F. A. Pearce, now Secretary to the Union. This preliminary effort was followed by a general meeting in May last, when it was decided to form the Union. The objects of the Union, I am given to understand, are: Remedying conditions applying to the shipping and railing of fruit. Better handling, prompt despatch, and the returning of "empties." Better train service for local markets, and greater facilities for protecting the fruit upon shipping wharves and railway stations, and suitable conveyance of fruit by rail and sea.

These are the business-like points of the Union, and it is hoped that at an early date it will also add to these objects by encouraging the better cultivation and treatment of fruits, the improvement of the present low standard of many sorts, the obtaining of a proper nomenclature of such fruits as are already grown, the use of uniform packing cases, and the grading of fruits.

There are now about 30 members of the Union, and it is hoped that ere long this will be greatly increased, and that up-country fruit growers will show a progressive spirit and encourage the growth of the Union by becoming members thereof.

During the year the Fruit Farmers' Union approached the Department with a view to effecting some arrangement with the Cape Colony, whereby citrus fruits from Natal should be exempt from examination and treatment at Cape ports. In order to secure this consideration representations were made to the Cape Department of Agriculture, the Natal Department offering to examine and fumigate all citrus fruit under expert supervision immediately prior to its being put aboard ship. The reply of the Cape authorities was to the effect that: the Minister of Agriculture, Cape Colony, was not prepared to authorise a departure from the present arrangement under which all citrus fruits are examined on entry into Cape ports. The Hon. Minister points out that only such fruits as exhibit traces of living scale, or other living pests, are subjected to fumigation, and, if the fruit is properly fumigated in Natal, there will be no living scale on it when it reaches Cape ports, and consequently if,

upon examination, it is found free of living scale, it would be passed without further treatment.

In addition, it is added that: "To alter existing regulations so as to admit certificated fruit from Natal without examination would prevent action being taken should it at any time become apparent, in regard to any shipment passing through, that in spite of the accompanying official certificate live scale was still present on the fruit—a possibility that might easily occur.

"Of even greater importance would be the danger of the introduction of pulp-infesting insects, of which there are at least two reported as attacking citrus fruits in Natal, one of which is only slightly known in Cape Colony, and the other, as yet, entirely unknown."

From this reply it will be seen that, whilst anxious to meet us as far as possible, the Cape people were not agreeable to go back upon their established principles and practices in these matters.

The objection to examination and treatment at Cape ports has arisen from the large shortage of fruits sent to Cape markets, a shortage which agents and others place (to my mind without reason) to the account of the official fumigation and treatment. There is, of course, always some fruit lost in treatment, because any that is decayed is thrown aside and destroyed, but the serious leakages in Natal consignments are attributed to some other cause. It was thought, therefore, that if the fruit is treated at this end the blame of the loss cannot, as it is now, be laid at the doors of the Cape Government officials.

The position which this Department has now taken up is that it will erect the necessary buildings and fumigating plant for treating fruit for oversea ports, but before doing so a guarantee of some sort must be given by citrus-fruit exporters that they will have their consignments examined and fumigated.

Arrangements were made to secure during 1902 a supply of living Humble Bees from England, with a view to acclimatizing them.

This movement has followed the representations from growers of red clover, who are anxious to produce

local seed of this plant. It is a well-known fact, of course, that this clover does not seed readily without the agency of insects, and it seems equally certain that red clover requires the assistance of the Humble Bee. It is hoped that this importation will prove as successful as it has in New Zealand.

GENERAL NOTES AND OBSERVATIONS OF 1901.

The following notes constitute a brief account of the observations made during the past year. Some are new and others have particular reference to points raised in my earlier report, which in several places I have had occasion to allude to.

THE MEALIE GRUB.

Sesamia fusca, Hampson.

(1st Report, pages 45-8, plate XI.)

Insect pests of the mealie plant have been very much in evidence during the earlier part of the season (1901–2). Up to the end of the year reports came to hand of the great damage done in some parts by cut-worms, in others by a large plant-bug which sucked the young mealies, until the plants wilted and died, and in still another locality a new pest, in the shape of a beetle (see page 17), made its appearance. These three pests were, more or less, confined to certain localities—the cutworms to the Mooi River district, the plant-bugs to New Hanover, and the beetles to Ixopo. The mealie grub, too, has been more in evidence than ever, and the amount of damage done by this insect has been considerable. Whilst some districts appear to have escaped its attack, in others crops have suffered more severely than for some time past. There are few farmers who have

any doubt with regard to the increasing depredations of this pest and the necessity of combating it in some way.

It appears to me that it is only by a close study of its habits and natural history that mealie-growers will be enabled to adopt cultural methods to prevent its increase, and I regret that I cannot point to any other solution of this trouble than a general improvement throughout the Colony in the cultivation of this staple crop. Fortunately there is ample room and opportunity for improvement in this direction.

In writing of the mealie grub in my first report I was in doubt upon two points. First, the situation in which the moth deposits her eggs upon the mealie; and, second, the manner of hybernation, or how the insect passes the winter.

With regard to the first point, I have not yet been fortunate enough to find the eggs upon a mealie plant, though I have made numerous observations which clearly point to the fact that the eggs are laid in batches upon individual plants.

Recently, also, Mr. A. E. Haviland, of Estcourt, wrote to me that he had observed a batch of eggs upon nearly every plant on 3rd December. The eggs were laid in an oval cluster of about 30, and placed inside the sheath of the bottom leaf, through which—owing to its transparency—the eggs can be seen.

My own conclusions are drawn from the number of adult moths caught upon the wing during November, and by the numerous instances in which I have found between two or three dozen young mealie grubs at a time in young mealie plants.

Concerning the hybernation of the insect, there now seems little doubt that at least one of my hypotheses was reasonably correct. That is, the winter is passed in the grub or larval stage, and in the mealie stalk. In support of this I may say that Mr. C. E. Hancock wrote, under date 7th November, 1901, that he had observed the caterpillars during the winter in the mealie stalks, the instance being particularly impressed upon his mind by the fact that the grubs were collected for

feeding chickens. Mr. Hancock surmised that the caterpillars hybernated until the young mealies grew again, then made their way into the young plants, entering from the base and travelling up the core.*

I have been particularly unfortunate, so far, in not being able to find hybernating larvæ, but Mr. Hancock's evidence is supported by the following observation: On 6th May, 1901, a mealie grub—nearly, but not quite, fully grown—was placed in a small cardboard pill-box. There it remained alive, without food, until the 14th November, in all 193 days. At that time it was placed near a young mealie plant growing in a pot, my object being to ascertain whether it would attack the plant, as surmised by Mr. Hancock. It at once burrowed in to the soil, but, owing to a regrettable accident, was lost several days afterwards. It is extremely probable, however, that it would have entered the plant. My observations in the field have shown that, where one young plant is infested with 20 to 40 caterpillars, it is impossible for that plant to support them all until they reach maturity, and, further, I have ample evidence of plants having been entered from the outside near the soil by caterpillars from adjacent plants. Whether my

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* Eersteling, Ixopo,
Nov. 7th, 1901.

Claude Fuller, Esq.

Dear Sir,

Accept my thanks for the copy of your report, which has duly reached me. In so far as I have been able to study it, it contains a great deal of useful information for us farmers, by which many will no doubt profit very greatly. In reading your remarks re Mealie Grub I notice on page 46 you say you are unable to say with certainty how this pest passes the winter. I think I can perhaps help you. If you pull up and split open the old mealie stalks, say in August and September, you will frequently find the live grub. They spend the winter in the pith of the stalk—below the level of the ground. So numerous were they, this year, in one field of mine—from which I had reaped a fair crop of mealies—that my wife, who reared a number of chickens by hand, set a Kafir umfaan every day to collect a supply of the grubs to feed the chickens on. I have hitherto been under the impression that these grubs on the land being ploughed over in the spring, escaped from the stalk into the ground ready to resume operations. My reasons for thinking so were, because having examined the caterpillar and cutworm with a magnifying glass, I was unable to detect any difference except in colour, which is easily explained, and, secondly because in some seasons the mealies, when about 18 inches high, are attacked from below and not from the top. On every plant attacked the grub has made an entrance below the surface of the ground and eaten upwards until the core is destroyed.

Yours faithfully,
C. E. HANCOCK.

correspondent's surmise — that hybernant caterpillars, from the previous autumn, attack the spring mealies— is correct, it is indeed difficult to say, but I must admit having seen instances of attack where a more plausible explanation could not be advanced.

THE WATTLE BAG-WORM.

Animula sp.

(1st Report, pages 51-55, plate XII.)

Reports of the presence of this insect in wattle plantations have been more numerous than formerly, and it is complained that of late it has also been more destructive.

Observations upon its life-history have been continued, and one or two fresh points elucidated. In this connection, I may mention it is recorded of several allied bag-worms, that the female insects either drop from their bags after depositing their eggs, or that the shrivelled remains of the female are devoured by its offspring before the latter leave their maternal home. In the case of the wattle bag-worm neither of these events occur, for the larvæ, hatching soon after the eggs are deposited, quickly sally forth into the outer world, leaving the dry remains of their parent behind them. Moreover, the female pupates with the head up and it is the apex of the pupa-shell which is thrust off, so that the female, emerging half way from the pupa-shell, when laying her eggs deposits them behind her in the hollow pupa-shell. It is true that, inadvertently, a female will pupate with its head towards the lower opening of the bag, as do the males, and in these instances they usually wriggle free from their bags and fall to the gronnd. In the breeding cages these fallen females have been noticed depositing eggs, which, however, proved unfertile.

Many former observations were checked during 1901, and in all cases the results were uniform with those of 1900, the various dates of emergence of the males and the larvæ proving practically the same.

The male moths made their first appearance upon

2nd September. Twenty-two days later (27th September) the eggs hatched and larvæ made their exit from the female-bags.

Check calculations were also made regarding the mortality among worms which had constructed bags and become about half grown. These so closely approximate those given before that repetition is needless.

The bearing which these natural studies have upon the control of the pest I do not presume to emphasize. In the first place they make it perfectly clear that for a considerable period (May to September) the application of poisons (as recommended for plantations of small trees) would be quite useless, as no worms are then feeding. They also show that such applications would be the more effective when made during the first week of October, as then the young larvæ would be destroyed before much damage could be accomplished.

In the second place it may be stated that in thinning plantations between May and December some advantage would accrue from the destruction of the limbs and foliage of the felled trees, as the bag-worms upon them do not require any food and consequently live to produce young in the spring if they are not destroyed by some agency or other.

FRUIT-PIERCING MOTHS.

Figure 1.—A Fruit-Piercing Moth.
(*Sphingomorpha chlorea*, Cran.)

In addition to the three moths of which I have already given a description, several other species having claims to rank as fruit-piercers have come under my

observation. These include several *Ophideres*, a further species of *Ophiuza*, and a small yellow moth—*Cosmophila Erosa*, Hubn.—which was caught in abundance upon China guavas in Maritzburg last May. For the Ophideres I am indebted to Mr. John Wakefield of Richmond, who has spent a great deal of time in the observation of fruit-piercing moths. Mr. Wakefield has also sent me a number of other species which he has caught at night time feeding on peaches and other fruits.

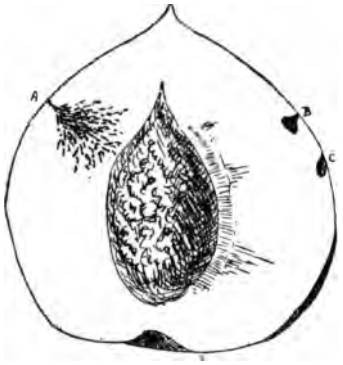


Figure 2.—Section of a Peach showing at A a moth puncture and at B and C cavities containing eggs of Fruit Fly, about natural size.

In connection with this form of insect attack, it would appear that a number of my readers have jumped to the conclusion that I was quite opposed to the generally accepted idea that these moths puncture the fruit. The evidence which I had before me when writing my first report was not sufficient to justify me in forming an opinion one way or the other; and this is still the case. I have not had any suitable opportunity of making further observations. Nevertheless I have been able to carefully compare the holes used by the moth with those made by the fruit-fly. In one instance, a considerable number of recently made fly-punctures were examined, more particularly in the peaches. In nearly every case—certainly in *every* case where eggs were found in the puncture—a cavity existed beneath the rind (see figure 2, B and C). The cavities measured $\frac{3}{50}$ in depth and the same across. I have already described the honeycombed appearance of a section of a fruit in the region where a moth has been feeding, and this is further illustrated in

figure 2. This figure represents a section of a peach collected at Verulam in December, and was chosen for the purpose of illustration because typical fly-punctures were found together with the work so characteristic of the moth. The cavity in which the fly eggs are laid has but a small opening, and this is more obscure and less defined than that left by the moth. No time has been found for experimental work bearing upon the controlling of these pests; nor has any further progress been made of their life-histories. Certain suggestions have been made for the repelling of the attack of the moths, but these have met with so little encouragement that I have not yet put them forward seriously.

THE KEEVER BEETLE.

Heteronychus arator, Fron.

This is a pest which has recently been reported by Mr. J. H. Lilienthal, Dronk Vlei. In furnishing me with specimens Mr. Lilienthal remarked that his attention was first drawn to the insect by an almost bare patch, in extent some 25yds square, in his mealie cultivation. Upon investigation, the beetle was discovered below the soil and just above the roots feeding upon the stem of the young mealies. Specimens of plants destroyed by this insect were sent me, and from these the beetle appeared to have torn away the outer leaves in order to get at the more juicy heart, so that, whilst the outer leaves were only withered, the centre of the plant was dried up. The amount of damage done in the case reported seems to have been considerable, as, after the cause of the mischief had been discovered, further evidences of its depredations were found all over the mealie field.

This pest, from enquiries which I have since made, seems quite uncommon to Natal. Indeed, Mr. Lilienthal, in sending the specimens, remarked that those local farmers and natives to whom he had shown the beetle

told him that they did not know of a beetle existing in Natal which attacked mealies.

Figure 3.—The Keever Beetle (*Heteronychus arator*, Fron.), from Ormerod and Janson.

It is, however, a well-known pest in the eastern parts of Cape Colony, where it goes by the popular name of "Keever Beetle," which I have used in introducing these remarks. It is said to be very wide spread, and generally injurious, especially to wheat. As in the case of the mealies, it destroys wheat by eating away the roots beneath the soil. According to opinions expressed in Miss. Ormerod's "*Observations on some Injurious Insects of South Africa*," the Keever Beetle deposits its eggs in the soil, and the grubs are equally as destructive as the adults. It is said "that the insects never attack grain "sown in ground newly broken up, even though it be "within a yard of their old scene of operations. The "ground must have been cultivated two or three years "before they attack the crops on it."

Figure 4.—A Cockchafer Grub.

The Keever Beetle is about three-fifths of an inch in length. It is quite black, oval in outline, and very convex. It belongs to the family *Dynastidæ* and has a very general resemblance to a number of small dung beetles. The grubs will resemble figure 4 in general appearance, but they will of course be smaller.

When the beetles are attacking mealies it is difficult to suggest any practical treatment, but where they appear in a crop I feel sure that hand-picking would prove very beneficial, as each beetle destroyed means several plants saved and makes a difference to the increase of the pest and the possible "infection" of the land for the future.

Mr. Lilienthal, in his letter to me, recognised the benefit of such a course, for he remarked that whilst he was unable to obtain the necessary labour to remove the beetles, in view of the danger of their laying eggs in the soil he intended to hand-pick as soon as possible.

Among some of the suggestions which have been made for checking the pest is the use of lanterns to attract the beetles when on the wing at night, and, also, the placing of small lots of fresh cattle-dung about a field to act as traps, that is to attract the beetles as a suitable nidus in which to lay their eggs, and then to remove the manure to the fowl-yard at intervals of three or four days. These suggestions I placed before Mr. Lilienthal, and his remarks thereon are very valuable, despite the fact that the evidence is quite negative. Under date of Jan. 8th he wrote:—"Your favour of the 20th ult, to hand. I have "since experimented with the beetle. I have tried the "fresh cattle-dung and find that, whilst numerous other "beetles came to it, none of these are attracted. Neither "are any drawn to the light at night; my open door and "lamp are facing the mealie cultivation, but to be certain "I have gone to the infested patches with a lantern."

The following further remarks are quoted from Miss Ormerod's book referred to above:—

"The Keever Beetle destroys potatoes, eating them "out and leaving only the empty skin."

"Farmers complain that beetles are found upon lands "that have never been manured."

"One farmer put lime upon his field and reports "that it has killed the beetles."

"We are generally troubled by them in dry seasons. "As a rule they are found upon red ground."

"I was advised to sprinkle with salt. This has b
"tried by a man living at Narraga, but has
"succeeded."

THE FRUIT FLY.

Ceratitis corysa.

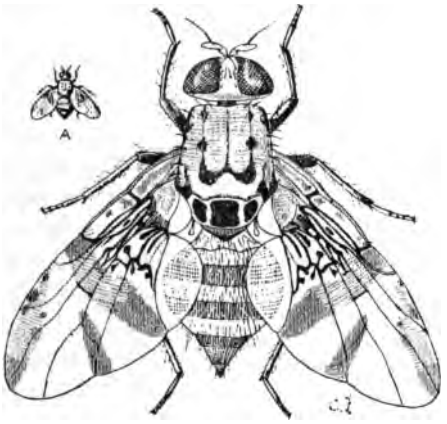


Figure 5.—The Fruit Fly (Enlarged and natural size).

This pest was, as usual, much in evidence du
the year, and a large number of fruit-growers are g
in more extensively for the netting, with which to pro
their fruit from infestation. A few further points ir
life-history have been elucidated, and I believe th
shall have to add grapes to the already lengthy lis
food plants. The grape in question is the Amer
Niagara, and my attention has been drawn to
characteristic fly punctures by Mr. G. C. Willi
As yet I have not reared the fly from these grapes,
Mr. Williams informs me that he has actually capt
flies with their ovipositors piercing the fruit.

All through last summer flies were reared in
tivity in one fruit and another up till the month of J
the last batch dying on the 9th July. Upon the
July, however, adults and larvæ were found in
warm parts of the Town Bush Valley, a few miles f
Pietermaritzburg.

The first brood of flies was reared from eggs deposited during the first and second weeks of November. This evidence points to a succession of broods ranging with certainty over at least nine months of the year, November to July, for elevations up to 2,300 feet.

My cage rearings also show me that flies will live in confinement, in a fairly equable temperature, when fed with fruit juice and sugar and water for a period of 30 to 40 days, from which fact one may reasonably conclude that under natural conditions they will live for a much longer period.

It has been ascertained also that eggs do not hatch for a period up to 4 days after being laid, that larvæ take in November 25 days to mature, and that the pupa period extends over 7-11 days.

Copulating of the sexes was not noticed until six days after flies emerged from the chrysalis stage. In my former report I stated that the flies always left the fruit to pupate. In the case of large yellow guavas this appears to be open to amendment.

I reared in my breeding cages some hundreds of these flies from these fruits, and in not one instance did the maggot leave the fruit—which was in a dry mummified condition—but pupated within the fruit after gnawing an exit hole. Should this habit, upon further investigation, hold good, under natural conditions it will go to show the great advantages which would accrue from gathering and destroying these fruit at the very least.

THE FLYING TICK.

Hippobosca struthionis, Janson.

This insect is frequently referred to in Natal as the "flying-tick," a name which it has possibly earned through its slight resemblance to the so-called "sheep-tick" (*Melophagus ovinus*), and also to its resemblance to the Forest Fly of Europe, often spoken of as the "horse-tick." Strictly speaking, of course, these insects have no relation whatever to the true ticks, or *Ixodidæ*, and are possibly only referred to as ticks from the fact

that they infest stock and, when attached to cattle, have some likeness to ticks. The species is known as the "Ostrich Fly," and is very common in parts of Cape Colony.

The Flying Tick is interesting on account of its remarkable method of reproduction, in which it differs essentially from the vast majority of flies, particularly those not belonging to the same family (Hippoboscidæ).* The members of this family, which includes the so-called "sheep-tick," do not lay eggs as do most insects, nor do they, like a large number of flies, produce their young alive in the form of active maggots. Moreover, these flies only bring forth their young one at a time; whereas flies in general produce batches of several dozen. They are especially abnormal, inasmuch as the eggs hatch and the larvæ develop within the abdomen of the adult, being nourished by certain secretions. The larvæ are not extruded until they have obtained development and are upon the point of becoming pupæ. Indeed, immediately after expulsion, the skin which covers a newly-born larva becomes hard and the insect becomes a pupa. The pupa stage of the Ostrich Fly is described by Miss Ormerod as much like little roundish white balls, with a brown spot on one side.

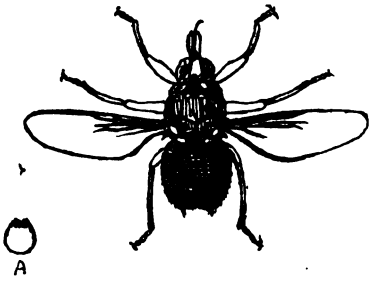


Figure 6.—The Flying Tick (*Hippobosca struthionis*, Janson.) Enlarged 2½.
A.—The Puparium.

The fly is a little over one-third of an inch in length of the body, but looks larger owing to the length of th

* The Tse-tse Fly reproduces its young in a similar manner to the *Hippoboscidæ*.

wings. With these organs expanded the width across is about nine-tenths of an inch. The body is somewhat flattened and wide, and more or less oblong in shape. The head is comparatively small and, like the thorax, of a horny nature. The abdomen is more of a leathery consistency and hairy. The wings are more or less oblong, rounded at the tips, and conspicuously veined to half their length. The legs are large, strong and spiny, and furnished with claws peculiarly adapted to travelling amongst hair. The general colour of the body is black, the abdomen being quite black. The head and thorax are ornamented with yellow spots and markings. The legs are a deep red colour; and the wings a light brown, with black veins.

Though nothing like so abundant as in the Cape Colony, the insect is not uncommon in Natal; and this description is being given because of the number of instances in which the insects have been sent to me for identification. It is not a serious pest here; but it is known to attack pigeons, ostriches, horses, and stock generally in the Old Colony. It irritates animals, not only by sucking the blood, but by creeping about with great activity all over the skin.

THE SHEEP TICK.

Melophagus ovinus, Lat.

The Sheep Tick (see figure 7), as this insect is called, is in reality a wingless fly belonging to the same family as the Ostrich Fly, which it resembles in its manner of reproduction and parasitism. Indeed, the chief point of difference between it and the other members of the family is that it never possesses wings. It is not by any means an attractive-looking insect, and the peculiar resemblance it has to a spider, due to the manner in which the small head is sunk into the anterior part of the thorax, has led to its being referred to by some as the "sheep spider." It measures about a quarter of an inch in length, and the skin is somewhat of a leathery nature and clothed with fine hairs. The thorax

is much narrower than in the winged members of the same family. The abdomen is large and the legs ample and strong. The general colour is of a red or greyish brown.

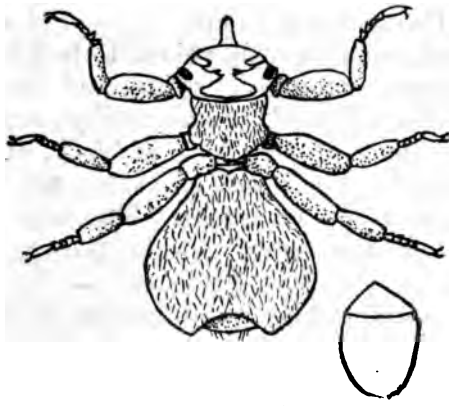


Figure 7.—The Sheep Tick. (Much enlarged).

The Sheep Tick, being without wings, does not leave its host voluntarily except after shearing, when, according to Osborn, it tends to migrate to lambs. The insect multiplies in the fleece, and finds its nourishment in the grease of the wool and in the blood which flows from its bites. The female has been found to produce from five to eight young, and the brown seed-like puparia are occasionally found amongst the wool. Every farmer has some acquaintance with this pest, which is found all the world over, and which, when neglected, is generally understood to increase sufficiently to cause a certain amount of damage. The pest, fortunately, yields readily to the influence of such dips as destroy scab, and so farmers ought to experience no difficulty in preventing its increase here, where systematic dipping is, or should be, regularly practised.

THE PLAGUE LOCUST.

Acridium pupuriferum, Walker.

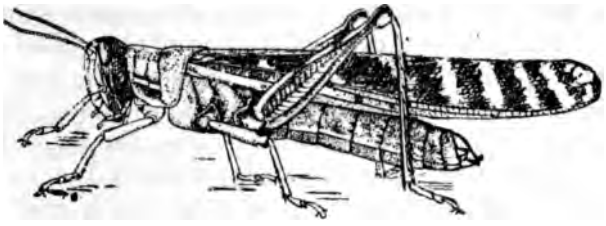


Figure 8.—The Plague Locust.

Towards the close of 1901, "locusts"—to use the term commonly adopted in referring to this pest—promised to be more generally prevalent throughout the colony than they have been for some time past. During the earlier part of the year they were, as usual, troublesome upon the coast, being more numerous to the south than in the north. The majority of the swarms which hatched out were, however, destroyed by the individual efforts of planters and by co-operation before they reached the flying stage. In all cases the use of the arsenic poison has proved successful, and the best method for dealing with the pest, whether in the veld or in cultivated lands. As an instance of what has been done, I may again refer to the work of the Inanda Association, the report upon which shows that altogether 1,021 swarms were destroyed, by the agents of the Association, at the cost of £161.

A good deal of similar work has been done by Mr. Stock Inspector W. C. Robbins, of Umhlali, who has also carried out several experiments with the soap solution. In the south coast district the work has been more among individuals, and I am credibly informed that upon one sugar estate over a ton weight of arsenic has been used in preparing the poison. The work of the Department did not extend beyond the contribution stage, about £200 being contributed towards the work of the Inanda Society, and about £90 to that of the Alexandra County Association.

With the first week of October swarms of flying locusts crossed the Tugela, some towards the coast and others higher up. The majority of those which crossed lower down seem to have laid their eggs in the more northern part of Victoria County and again south of Durban. Those which crossed higher up travelled along the 3,500 ft. plateau, passing over Maritzburg in a more or less south-easterly direction. One of these swarms according to the account of several, was the largest that has ever passed over the city. It deposited eggs on a belt of country lying in a line between York and Richmond. Curiously enough, along the Greytown railway to the Town Lands of Pietermaritzburg and upon the other side of the city, along the main railway as far as Manderston, and then branching south with the Richmond railway to Arnold's Hill. The eggs deposited by this swarm commenced hatching out during the last week of the old year, so that the work which I have undertaken in connection therewith hardly comes within the scope of this report. Still it may be stated that every encouragement has been given to farmers to destroy these swarms, and gratuituous supplies of poison distributed. It is, therefore, reasonably hoped that, if not all, at least the vast majority of locusts hatching out will be destroyed before they acquire wings. A further invasion of flying swarms occurred further up-country, and eggs were deposited during December in the neighbourhood of Gourton. The locusts seemingly came from across the Drakensberg and in the opposite direction to the other visiting swarms.

With regard to the preparation of the arsenic poison for destroying locusts, I may say that the formulæ given are those usually supplied me by practical parties who have had a good deal of experience. It is remarkable how much they vary, however, and it may be well to state that recently I have recommended a different formula than that given in my last report. There are two points upon which the practical locust-killer agrees, no matter what formula is used, and these are—that the solution must be strong and that it is the sugar or treacle "which does the trick." The following is the formula

which I have suggested recently, and which I know has received a very thorough trial:—

Arsenic	1 lb.
W. Soda	½ lb.
Treacle or Sugar	5 lbs.
Water	10 gallons.

Of course this is very strong, and 1 lb. of arsenic is sufficient for 20 gallons—1-10 acts very quickly and so gives satisfaction. The soda is slightly in excess, but not too much so; still it could safely be reduced to ¼ lb. if the liquid was well boiled for fifteen minutes and the solution used at once. The half pound of sugar to the gallon is just sufficient. Coast people prefer to use a larger proportion of sugar—1 lb. to 1 gallon of water one recommends; but then sugar and treacle are more easily obtainable on the coast and perhaps cheaper.

The use of soap-solution has recently come in for a good deal of adverse criticism, but it has not been the fault of the solution, which, when carefully applied, so that the locusts are wetted, is quite satisfactory.

A feature of the invasion of flying swarms from the north, which is worthy of more than passing comment, is the great number of parasites which were found in the "egg-pods." It will be remembered that in my last report I drew attention to the remarkable absence of Dipterous or fly parasites of locusts, and now they have appeared in great numbers. I cannot faithfully say, however, that they appear to have made much impression, though there is no doubt the swarms of young locusts are less numerous than they would otherwise have been. I understand that these parasites were noticed in the eggs of the first swarms visiting Natal, and it is hoped to give some account of them at a later date.

THE BLACK PEACH APHIS.

Myzus cerasi, Fabr.

Among many other items of interest in the pages of the last annual report to hand of the Cape Government Entomologist, mention is made of the fact that a considerable number of peach trees from Australia

were seized and destroyed in Cape Town because they were infested with Black Aphis. Such drastic measures of this nature lead one to the natural conclusion that the pest has not got a foothold in the Old Colony. Such a happy state of affairs does not, however, exist in Natal.

Upon several occasions during the past two years I have noticed this insect in different parts of the Colony and, from enquiries, it appears to have existed here for some considerable time. Last spring, however, the pest was particularly abundant and, in some cases, the damage done was very evident. The aphis is not as yet very general, and it is hoped that an effort will be made by fruit-growers to keep it from spreading.

Europe is supposed to be the original home of the Black Peach Aphis, and there it is the cause of much damage to cherry trees, a circumstance to which it owes its specific name *cerasi* (from the Latin *Cerasus*, a cherry tree).

These aphides, in general characteristics and in habits, greatly resemble the many other aphides common to farm and garden, such, for instance, as the corn, rose and turnip aphides. In this respect they are small, soft-bodied creatures of social habits, and feeding upon the juices of the host plant, imbibing them through a rostrum or beak suited for piercing the tissues and pumping. In common with other aphides, also, the damage which results from their attack is due to the huge swarms in which they occur, and the multitudes which infest a single plant have their origin in the marvellous reproductive functions belonging to this group of insects. These procreative powers, coupled with an extraordinarily prolific nature, readily explain their rapid increase.

It would, however, occupy far too much space to give a full account of these functions here, and it may be briefly stated that the insects have a sexless reproduction for the greater part of the year. The individuals possessing this remarkable function are known as "stem-mothers," and they produce young possessing similar functions through many generations. These

"stem-mothers" arrive at maturity—in the case of the Black Peach Aphis—when ten days old (September and October), and give birth to an average of between five and six young per day uninterruptedly for about twenty days, at the end of which time, from observations which I have made, each "stem-mother" is the progenitor of about 2,813, and in seven weeks is the grandparent of 12,210 aphides and the great grandparent of some thousands more.

Having once realised the prolific and rapid powers of multiplication possessed by these insects, the farmer can easily foresee the probable outcome of a small patch of aphis on any of the plants under his care, and he can also appreciate the value of a treatment which, if it does not destroy every aphis, at any rate will destroy fifty to eighty per cent. of them.

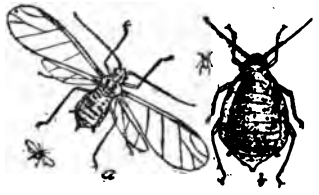


Figure 9.—Aphides, winged and wingless.
(The small sketches indicate roughly the natural size of the insects.)

The effect of the attack of the Black Peach Aphis is particularly noticeable in the spring, when the new growth and foliage is much stunted and deformed, and encrusted with multitudes of the lice. If such an infested twig be examined, the insects will be found in several different forms. The young aphides are a light brown and somewhat translucent, whilst the adults are of an intense and shining black. Amongst these latter, numbers of winged insects will be noticed, and, also, others with the wings just forming and still in the form of pads, pressed closely to either side of the thorax. This latter form is spoken of as the pupa or nymph, and from it develops the winged individual.

Its appearance among a colony appears to be due to the growing shortage of supplies, and the consequent necessity for a search for more food. The flying aphides have four wings, with which they can travel by the aid of the wind for good distances. The winged insects possess the same procreative functions as the wingless, and whilst they are never so numerous, still they help to spread the pest to a very great extent.

In Maritzburg the aphis may usually be found upon peach trees all the year round. During the winter and hot summer months it confines itself more to the under-surfaces of low-lying branches, and also around the trunk just beneath the surface of the soil. In the shelter of my own garden I also noticed it upon suckers in leaf throughout the winter; and very early seedlings which sprouted there all had a colony upon the crown of the root early in September. Reproduction goes on very slowly during the heat of summer and throughout the winter, but directly the buds begin to swell the aphides begin to reproduce rapidly. In the instance under my observation this spring the tree was well infested before the flowers were out in August, and during September the pest multiplied very rapidly, and did considerable injury, despite the early advent of the rainy season. The effect of the attack is to dwarf the growth and prevent the setting of the fruit, and shoots which should be five or six inches long remain stunted in the form of rosettes of distorted leaves. After a good spell of rain the tree recovers and makes some headway, but never makes the growth that it should, or produces the fruit which is expected of it.

Treatment.

The Black Peach Aphis succumbs readily to contact insecticides, and for this purpose either paraffin emulsion or a decoction of tobacco and soap may be used with advantage. To be at all thorough, the treatment must, of course, be an early one, and it is best to start by destroying those on the crown and lower part of the tree during the cold weather. For this purpose the applic

tion of about two gallons of a solution of bluestone containing one ounce to two gallons of soft water has been recommended by the Victorian Entomologist. This is applied after the removal of some of the surface soil.

In spraying trees for this pest, either the diluted paraffin emulsion or the tobacco and soap solution, the formulæ for making which are appended, may be used.

In obtaining pumps, one is limited to the local supply, and so I can only recommend the "Deming Success" or "Galloway Knapsack," or the Nixon pump fitted to a barrel. To all these pumps Deming's fine "Vermorel Cyclone" nozzle should be attached for this work in preference to the "Bordeaux" nozzle, or any of those supplied with Nixon's pump, as it throws a much finer spray.

Deming's pumps are stocked by Messrs. Wilkinson and Co. and Steel, Murray and Co., Pietermaritzburg, and by Messrs. P. Henwood, Soutter and Co., Durban (the latter firm also stock Nixon's pumps).

Paraffin Emulsion.

Soap ...	...	... $1\frac{1}{2}$ lbs.
Paraffin	...	... 5 gallons.
Water ...	...	... $2\frac{1}{2}$ gallons.

Take whale-oil or common bar soap; cut up and boil until dissolved in water. While boiling, add solution to the paraffin. Churn violently; five minutes if with pump or syringe, or fifteen if with paddle. Dilute, using nine parts of water to one of the emulsion.

Tobacco and Soap Solution.

Tobacco (strong) ...	...	2 ounces.
Soap (common) ...	...	5 ounces.
Water ...	...	... 1 gallon.

Boil the tobacco thoroughly and strain; dissolve soap in hot tobacco solution and make up to one gallon.

THE RED PLANT-MITE.

Bryobia, sp.

Generally regarded as an insect pest, and more or less incorrectly spoken of as a spider, this small mite, during dry spells of weather, does a considerable amount of damage to various plants. It is one of the very few pests of the tea-plant in Natal,* but does little material harm to it. The list of plants upon which it thrives, however, is a very long one, and to many of these plants it is capable of doing a great deal of damage. One of the worst cases which has come under my observation has been that of a large grape vine, the greater part of the foliage of which was destroyed within a remarkably short time. Young gum trees and "Cape" gooseberries suffer a great deal, and beans, peas, and other legumes are also favourite food plants. Very many other plants suffer to no small extent, and the pest may, with assurance, be said to exist in every garden.

In the Cape Colony the pest is referred to as "Bryobia Mite," a name which originates from the technical name of the species, and one which is used to distinguish it from a very similar mite well known by the name of "Red Spider."

This mite belongs to a group containing a number of closely allied species doing similar damage to plant life. They are generally referred to as "Harvest Mites," and some are called "Spinning Mites," because they weave extremely fine webs over the leaves which they infest. The one in question does not, however, have this habit.

The "Mites" constitute a very large order, spoken of as the Acarina, and to it belong the mange, itch and scab mites of dogs, horses, and stock generally, the cheese and flour mites and the ticks. The Harvest Mites belong to the family *Trombidiinæ*, and are related to spiders. They are characterised chiefly by the possession of eight legs in the adult stage, and in the earlier stages six. They differ from the spiders on the one hand in never having the abdomen joined to the

* The soft scale *Lecanium hemisphericum* is the only other I have noticed.

body by a narrow point of attachment, and from the scorpions on the other hand in never having the abdomen segmented.

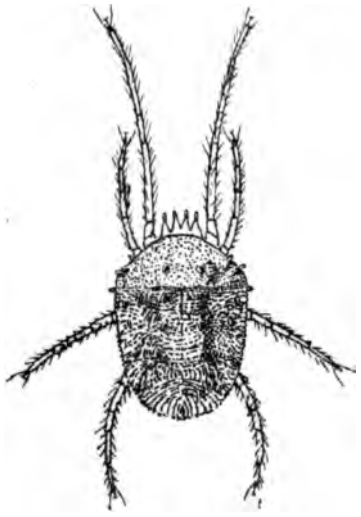


Figure 10.—Red Plant Mite. (Greatly enlarged).

This "Red Mite" is very minute, and resembles but a small speck of colour when seen with the naked eye. It is, however, not its size, but the numbers in which it occurs, that enables the species to do so much damage.

The eggs are shining and red in colour, and so small that they are difficult to observe. Under the microscope they resemble small glass beads. The young mite which hatches from the eggs is usually of a light colour, and, like the young of the tick family, only possesses three pairs of legs, the extra pair being acquired when the animal enters the third stage of its existence.

Some of these mites are called "Red Spiders," partly because of their relationship to spiders and because, in the adult stage, they are of a red or reddish-brown colour.

The injury which they do to plants is more or less confined to the foliage, and the result is a very characteristic yellowing or "marbling" of the surface of the affected leaves.

As a general rule, the mites are found upon the lower surfaces of the leaves, but in the case of the grape-vine, tea-plant, and gum tree only the upper surface is attacked.

Treatment.

The treatment of the pest is more or less restricted to spraying with paraffin emulsion or sulphuring with dry flowers of sulphur. The former treatment has, I believe, yielded good results in the hands of Mr. Lounsbury, the Cape Entomologist, whilst sulphuring is generally well spoken of. Sulphuring should, however, be applied with a special sulphuring bellows when the mites are upon the undersurfaces of the leaves.

In many cases, of course, it is far better to cut off the infested plants and burn them quickly, or else, by irrigation, to induce the more vigorous growth.

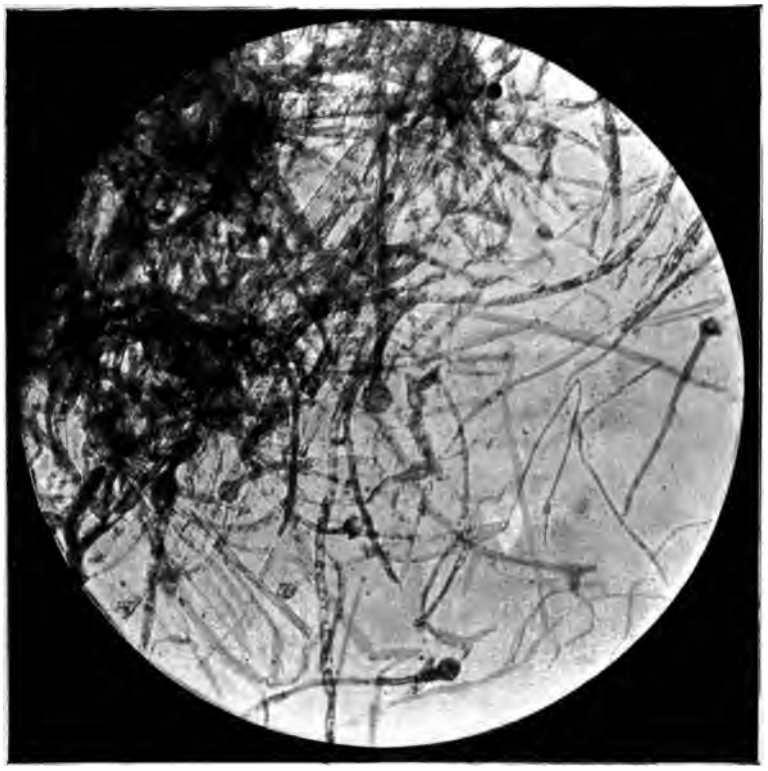
THE SOUTH AFRICAN LOCUST FUNGUS.

Mucor exitiosus, Massee.

Mucor locusticida, Lindau.

As the "Locust Fungus" has now such a world-wide reputation, it may not be out of place in this report to place on record some interesting correspondence and notes relating to it; more especially seeing that the fungus was first taken notice of, and put to a practical purpose, in Natal. Before entering into any discussion, however, I should like it to be distinctly understood that I am no advocate of the use of fungus. Local circumstances have compelled me to take up this position, not the least among these being the fact that, directly its use is approved of, the one-hundred-and-one incredible reports relative to its alleged success are supposed to be endorsed, and it is supposed to be recommended before any other form of treatment. My position, however, may seem somewhat anomalous. I approve of all that has been done and is being done with the fungus so far as its preparation and distribution is concerned; but I consider that the

Plate 1.



Microscopic View of the Locust Fungus.
Enlarged 230 Diameters.

artificial infection of locusts with fungus should only be resorted to when every other form of treatment is impossible, and that he who uses the fungus, when he could by other means destroy the pest (particularly in the crawling stage), is endeavouring to hide a very large light of laziness behind a short-weight bushel of rectitude.

Approaching the subject in a perfectly fair spirit, it must be admitted that the "locust fungus" is the greatest "natural check" upon the pest existing, and the amount of damage which the disease saves the Colony from is not to be estimated. It can, however, be roughly gauged by the great number of visitant flying swarms which succumb to its effects. The death from fungus of the locusts constituting these swarms is generally attributed to artificial infection; but this is often most improbable, for who can with certainty state that the swarm which he infects here to-day is identical with that which he finds dying of fungus a week or a fortnight later, anywhere from three to thirty miles distant from the previous place? And yet how many have confidently made these statements when climatic conditions alone have shown their contention to be absurd! No, the artificial infection with fungus ought not to be boomed in this Colony now that we know how uncertain a matter it is, and now that we have, if not as cheap, certainly effective methods of dealing with the pest. The fungus left in Nature's hands will do all that it can reasonably be expected to do.

Whilst not attempting to define my anomalous position of both critic and appreciator, I feel bound to express my recognition of the work done by those who first brought the fungus under notice, and whose advocacy led to its artificial production and distribution throughout South Africa.

Historical.

Unwittingly several gentlemen have been individually credited with being the first to draw attention to this fungus parasite. The honours, however, are—to use a time-honoured phrase—easy. In the division, however,

the claims of one gentleman—our veteran Botanist, Mr. J. Medley Wood—appear to have been entirely overlooked. Mr. Wood's claims for priority are unimpeachable, as the following letter, copied from the records of the Colonial Secretary's Office, amply demonstrates :—

"Natal Botanic Gardens,
"Berea, Durban, Natal,
"4th April, 1895.

"To Sir JOHN ROBINSON, K.C.M.G.

"Dear Sir,—Yesterday afternoon some dead locusts, which had been brought to Durban by Mr. Marshall Campbell, were sent to me by Mr. M. S. Evans for microscopical examination.

"I find that the locusts have been killed by a fungus, I think one of the *Entomophthoreæ*, but I have no authentic descriptions of the genera or species, and am therefore unable to identify it more closely.

"Nearly the whole of the viscera of the insect has been destroyed by the fungus, and the mycelium in a state of fructification appears outwardly at the joints of the abdomen. The spores of these fungi retain their germinating power for, say, 10 to 14 days, and I would therefore suggest that the diseased, or dead insects should be collected and distributed amongst healthy swarms in other parts of the Colony, which would not entail any great expense. Probably the dead, insects would convey the disease as readily as living ones, provided too long a time has not elapsed since their death, as the spores as a rule only mature and are disseminated after the death of the host. I am about to obtain some healthy locusts from another locality and try to inoculate them with the disease.

"I am, Dear Sir,
"Yours sincerely,
"(Signed) J. MEDLEY WOOD."

The same records show that Mr. Wood's advice was valued by the then Colonial Secretary, for it was at once officially communicated to the local Press and to the Magistrates of the Colony.

Of interest, too, is Mr. Wood's later account of the occurrence, which I give verbatim, for it has some bearing upon other correspondence which follows. Writing to me under date of 7th November, 1901, Mr. Wood stated:—"The circumstances were as follows: Mr. Maurice Evans and I were walking down West Street (Durban) when we met Mr. Marshall Campbell and Mr. — Don, who said that they had something to show us. We then went to Mr. Don's office and were shown some twigs of sugar-cane on which were a number of dead locusts. Both Mr. Evans and myself at once saw that they had been killed by a fungus. Mr. Evans took the specimens, and my "boy" called at his office in the afternoon and brought some of them to the Botanic Gardens. After I had examined them, I wrote the letter (see *ante*) to Sir John Robinson, who was then Colonial Secretary, and during the same week Mr. Evans wrote, after having communicated with me by telephone, in somewhat similar terms to the *Natal Advertiser*. All the credit of having cultivated the fungus belongs, of course, to Mr. Arnold Cooper."

The next step brings us to the work of Mr. Cooper, which I think has been fully appreciated and recognised in all quarters; and there is no doubt that it is to this gentleman's endeavours that the present fame of locust fungus is due.

This "Locust Fungus" has of late been cultivated and tried in South America, North America, and Australia; and a certain amount of success has attended the infection experiments. Upon the whole, however, the reports up to date upon the practical results are not particularly encouraging. A natural sequence to the reputation acquired by the fungus has been the wish of many to have it properly determined, and several gentlemen have made examinations with this object. Upon this point the following very able letter of the Cape Government Entomologist to the Director of the Royal Gardens, Kew, and that official's acknowledgment will be read with no small amount of interest.*

* Copies of this correspondence were transmitted for the writer's information by the Department of Agriculture, Cape Colony.

[Copy.]

"Cape of Good Hope,
"Office of the Government Entomologist,
"Capetown, 6th January, 1900.

"To the DIRECTOR,
"Royal Gardens,
"Kew, England.

"Sir,—I take the liberty to address you with the object of requesting the favour of Mr. Massee's invaluable opinion on the identity of the fungus or fungi cultivated and disseminated for the destruction of locusts in this Colony and Natal. The economic value of the fungus appears to be considerable, and on this account alone an authoritative determination is very desirable. There is now a second and more urgent reason, as you will gather from what follows.

"To begin at the beginning—the earliest mention, to my knowledge, of an important locust-destroying fungus in South Africa is a note in *Science Gossip* for June, 1895, by Annie Lorraine Smith. Miss Smith records the observation by Maurice Evans, a Natal naturalist, of the havoc wrought in the swarms of the migratory locust by a fungoid disease, and notes that at the British Museum, to which alcoholic material was sent by Mr. Evans, the mortality was found to be due to a species of *Entomophthora*. Reference is then immediately made to *E. grylli*, Fres., in such a manner that one can only infer the Natal fungus to have been unquestionably referred to this species, although the wording is such that the statement is not directly made. In the same journal for October is a note from W. L. Distant, Pretoria, mentioning that the extraordinary mortality among the locusts was noticed in his locality. In apparent ignorance of this determination and record, Arnold W. Cooper, of Richmond, Natal, drew public attention to the disease early in the following year, and largely as an outcome of Mr. Cooper's efforts arose the cultivation of the fungus for general distribution by both this and the Natal Governments. Up to the present time cultures are still made and sent out under the simple term 'Locust Fungus.' However, from the examination of cultures from Cooper's

original material at Grahamstown in May, 1896, Dr. Black, of the Bacteriological Institute, in conjunction with Dr. Schonland of the Albany Museum, concluded that the fungus was an *Empusa*.

"I do not think that either of these gentlemen knew at the time of the *Science Gossip* note, but Dr. Schonland at least became cognisant of it very soon afterwards, as he called my attention to it in the following month.

"In October, 1897, Dr. Black contributed notes on the disease to the South African Philosophical Society (pp. 68-76 Trans. S.A.P. Soc., Vol. IX., part 2), in which no mention is made of the fungus sent to the British Museum and its determination, and in which doubt is thrown on his original impression that the fungus belonged to the Entomophthora group. In the same volume, under the date May 11th, 1897, Mr. Cooper has notes in which he states he believes the fungus to be an *Empusa*, probably new, and for which he suggests the specific name of *acridii*. Dr. Edington, the Director of the Bacteriological Institute, from recent studies, also believes the fungus to be an *Empusa*, and recommends Mr. Cooper's suggestion to call it *acridii* (p. 88, 1898 Annual Report).

"Meanwhile the fame of 'Locust Fungus' has spread far and wide. Cultures from Dr. Edington* have reached Mr. D. McAlpine, the Government Vegetable Pathologist of Victoria. He examined it and pronounced it without reservation *Mucor racemosus*, Fres. This determination was made public in the *N.S.W. Agricultural Gazette* for November of this year. I wrote and called Dr. Edington's attention to it, and in reply he has written :—'The fungus is not a *Mucor*, but an *Empusa*. On this point see my last annual report. I have not seen McAlpine's determination.' I also mentioned McAlpine's note to the Natal Entomologist, and he replies that for some time past there has been a suspicion in Natal that the locust fungus of the Cape for some time back has been unlike the original disease discovered by Cooper† and therefore that perhaps

These cultures were forwarded from Cape Colony by the writer at the request of Mr. Chas. French, Government Entomologist, Victoria.—C. F.

† In the opinion of some, there exist two distinct fungus parasites of the locust—the one under discussion and the other an *Isaria*.—C.F.

McAlpine is in the right. Thus you see we are now far worse than with no determination at all, and that the term locust fungus may be no longer specific in its application. If not specific, then results obtained in the use of one or the other fungi confused cannot be referred to its proper source. It is claimed that the Cape fungus may be employed for the destruction of lepidopterous larvæ, and I am desirous to test the assertion, but, owing to the uncertainty of the identity of the fungus, any results obtained would be of uncertain value. Moreover, should the Cape locust fungus now disseminated be *Mucor racemosus*, most unhappy effects might follow its free use on fruit trees—and it is against fruit-tree caterpillars that experimental work would be directed.

"I have talked over the matter with Professor MacOwan, our Government Botanist, and it is at his suggestion that I write to you. Whatever the Cape fungus may prove, Dr. Edington has abundant testimony to its efficacy as a locust destroyer.

"To avoid unnecessary delay, should you approve of the favour I have made bold to request, I am having despatched to you in a parcel accompanying this letter tube cultures of both the Natal and Cape fungi. That from Natal was received within a week through the Natal Entomologist, while the Cape cultures are part of a lot sent me by Dr. Edington on the 18th of last month. I am also sending a copy of Dr. Edington's 1898 report, in which he has notes on his fungus, and a copy of Mr. McAlpine's note in the *N.S.W. Agricultural Gazette*.

"I have, etc.

"(Signed) CHAS. P. LOUNSBURY,

"Government Entomologist."

[Copy.]

"Royal Gardens, Kew,

"February 7th, 1900.

"To Sir EDWARD WINGFIELD, K.C.B.,

"Colonial Office,

"Downing Street, London.

"Sir,—I have the honour to inform you that I have received an application, dated January 6th last, from the

Government Entomologist attached to the Department of Agriculture, Cape of Good Hope, inviting my opinion 'on the indentity of the fungus or fungi cultivated and disseminated for the destruction of locusts' in that Colony and Natal.

"2. It appears that in 1895 Mr. Maurice Evans, a Natal naturalist, noticed the 'havoc wrought in the swarms of the migratory locust by a fungoid disease.' As an ultimate result the artificial 'cultivation of the fungus for general distribution' by both the Cape and the Natal Governments has been undertaken on a considerable scale. The cultures are 'made and sent out under the simple term locust fungus.' Doubt has been thrown on the correct identification of the fungus by Mr. D. McAlpine, the Government Vegetable Pathologist of Victoria. The question has now been referred to me for decision.

"3. The question is *prima facie* of some importance. If in the course of continued cultivation one fungus were replaced by another, without the occurrence being recognised, it might happen that the method became unsuccessful without the reason being apparent. It appears from the correspondence that the Natal Entomologist has reported that 'for some time there has been a suspicion in Natal that the locust fungus of the Cape for some time back has been unlike the original disease.

"4. Whatever the Cape fungus may be, there appears to be abundant testimony to its efficacy as a locust destroyer.' It has been despatched to Cyprus, Algeria, South America, and many other parts of the world. The material received from the Cape has been examined here. The fungus is readily cultivatable, and proves, as Mr. McAlpine suspected, to be a species of mould (Mucor), which is apparently new and undescribed. A full account will be published in the *Kew Bulletin*. It is found at Kew to destroy cockroaches readily. It was proposed to employ it against fruit-tree caterpillars. But it is found to grow very freely on pineapples and grapes. It would therefore be necessary to proceed with caution before spraying fruit trees with the spores in suspension.

"5. I have to ask that the information contained in this letter may be conveyed to the Cape Government.

"I am, etc.,

"(Signed) W. T. THISELTON DYER.

"Sir Edward Wingfield, K.C.B.,

"Colonial Office,

"Downing Street, S.W."

As the outcome of this correspondence we now have an interesting account from the well-known Mycologist, Mr. G. Massee, in which the fungus is discussed and described as a new species under the name of *Mucor exitiosa*. Mr. Massee's account is published in the *Kew Bulletin*, p. 94, 1901.

SUGAR CANE DISEASE.

Some three years ago, at the request of the sugar planters, the Department of Agriculture imported from India a variety of sugar cane known as the "Poonah."

Late in the year I was instructed to make an examination of a field of this cane at Sea Cow Lake which had been reported by the proprietors, Messrs. Townshend Bros, as having developed some disease new to them. The following notes, bearing upon the subject, have since been supplied me by Messrs. Townshend Bros., and will serve to introduce the remarks I have to make upon the disease.

"We received a muid sack full of what had been at one time—to all appearance—very finely developed, healthy canes, but now much shrunken by the length of time taken in transit, in fact they looked so dry that we had small hopes of saving much.

"We immediately transferred them to a plot previously prepared for their reception behind our mill so that they could be irrigated throughout the driest months of winter. Of the whole lot only 24 eyes grew, but these were so well tended that by the first week in the following spring we had some fine healthy plants to put out. These were cut into very short sections of three eyes each and planted in a plot adjoining the original one. Sufficient cane was available by the end of the same season to extend this plot, making it about

16x20yds. The spring of 1899 saw the cane standing on the original and second plots in splendid form, having been liberally treated with stable and chemical manures, etc., and in our opinion perfectly healthy. The canes from these plots were planted out in the same manner as other canes upon the estate and covered a little over two acres of hillside. Below them we had 'Yuba' and above them 'Lousier.' When twelve months old this plot was sold to a planter and at that time we noticed no signs of disease. The second crop from these roots, however, showed disease, but not until the cane was ten months old. The first appearance of the disease we noticed in the leaves, which had a certain red appearance noticeable from a distance. We did not take much account of it at the time, as we had seen something similar appear on 'Green Natal' under certain conditions. Two months later this appearance had developed so much that we made an examination and found the cane diseased to an alarming extent, the stools in many cases having nearly died out. What struck us more particularly was that the other canes ('Yuba' and 'Lousier') growing quite contiguous to the worst affected parts of the "Poonah" showed no signs of infection nor loss of vigour."

"We cannot think that the disease was caused by the treatment the cane received, as they were as well manured as the neighbouring canes and showed nothing of the red leaf in the first crop, and only in the second after what appeared to us a healthy period, the young ratoons looking particularly well."

This plot of cane was examined by me upon December 10th, 1901. It was situated, as described by Messrs. Townshend Bros., upon a hill-side, the ground being somewhat stony and well drained. The adjacent crops of "Yuba" and "Lousier" had been removed, but several stools of both varieties were found growing amongst the diseased "Poonah," and these were to all intents and purposes quite healthy and free from the malady affecting the Indian cane. On looking at the plot, I was at once struck with the large amount of dead trash and canes, and the cramped condition of the leaf-spear—a feature particularly noticeable when compared with the leaf

heads of the "Yuba" and "Lousier." Scarcely a healthy cane remained among the "Poonah" and the majority were very much decayed. Some of the healthier were selected for examination. These had the appearance of being scorched upon the one side, the scorched areas originating 12 to 18 inches above the soil and extending the length of several internodes. These scorched areas only represented the external force of the disease, but they were sufficient to account for the serious effect upon the vigour of the plant. They varied in length, but in all cases were more or less linear, tapering down towards each end, and extending more around the cane at the middle (see figure 11 A). The more affected internodes were pinched and shrunken and sometimes diseased all round.

Figure 11.—Diseased Poonah Cane.
Diseased areas shown at A. A.

Cross sections through the cane showed that the disease extended much further up and down the cane than appeared from the superficial indications.

The cane juice was somewhat soured, disagreeable to the taste, and the pulp, throughout the stalk, of an appear-

ance not normal. Messrs. Townshend assured me that in passing it through the mill (for some had been cut) it acted differently to normal juice and had an unpleasant odour.

No further field examination was made; and it was considered advisable that the remainder of the cane should be got rid of at once and the trash, etc., burned.

Diseased canes were selected from the field about the 24th of November and 10th December, and these were more critically examined in Maritzburg. The lot selected in November was healthier in appearance than those taken later on, particularly certain parts which externally, and to a certain extent internally, appeared fairly sound. Mention is made of this on account of later developments.

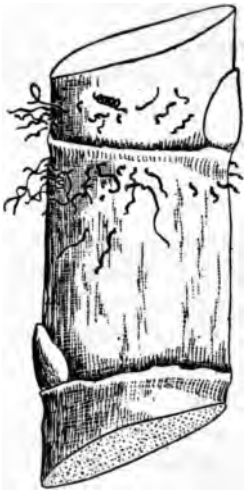


Figure 12.—Portion of Diseased Cane showing peculiar spore growths.

A microscopic examination of the tissue of the cane showed that the cells were greatly invaded by the hypæ of a fungus (see Plate II., figure 2), and it appeared from a number of comparative examinations that this fungus disease had gained an entrance through the cracks in the cane, a number of which are to be observed in "Poonah" as well as in other varieties of cane. Owing to the absence of spores, it was not possible to determine the fungus, and the canes were put aside to allow the parasite to fructify. Spores were noticed in abundance upon the canes about a month after they had been cut.

The fructification of this fungus is very interesting and not of the usual form which I have described in other notes upon fungus diseases. The spores are produced in bundles of black hair-like threads, which appear as if exuded, under pressure, through pores about the nodes of the cane (see figure 12). The threads are curled or crinkled and of a very brittle nature, and the spores are only seen when a piece of this black exudation is placed in water and examined under the microscope (see Plate II., figure 1).

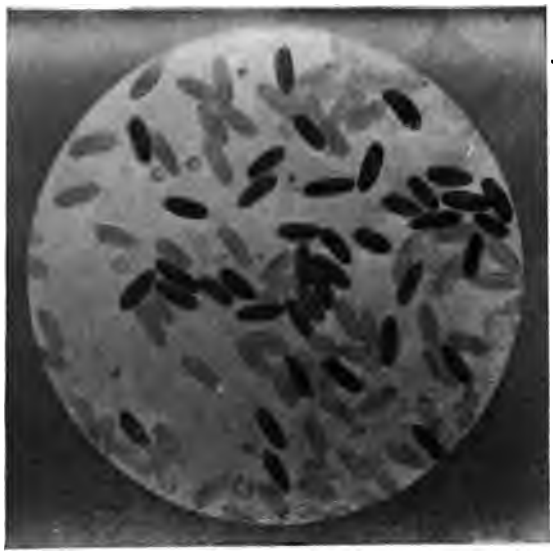
From all appearances the fungus causing the trouble in this case is identical with that described by Dr. N. A. Cobb as "Cane Spume" *(Strumella sacchari)*.*

From my examination of the "Poonah" cane it appeared that the fungus had gained an entrance through the cracks in the cane. I should not care, however, to be too positive upon this point, as I have not come across any other cases of the disease, nor has it appeared in the "Poonah" cane grown by several other parties. Dr. Cobb speaks of it as being "one of the most prominent and striking fungi" attacking sugar cane in New South Wales, and he believes "that it is true that in most cases, if not all, the fungus requires the cane to be first injured in some way." Speaking further upon its effects he says, that, "In many fields upon the Lower Clarence River, stalks dead and covered with spume may be counted by the thousands, and there are no fields altogether free from the disease. The amount of damage done by spume, is difficult to estimate. There is no doubt that through its agency much cane, which, though injured, would be saleable, is soon rendered worthless. Let the cane farmer go into his field, and count in one row the dead stalks showing the black pustules of spume. Then multiply this by the number of rows in his field and he will soon know the amount of his loss in this direction, and he can then tell how much he can afford to spend in combating it."

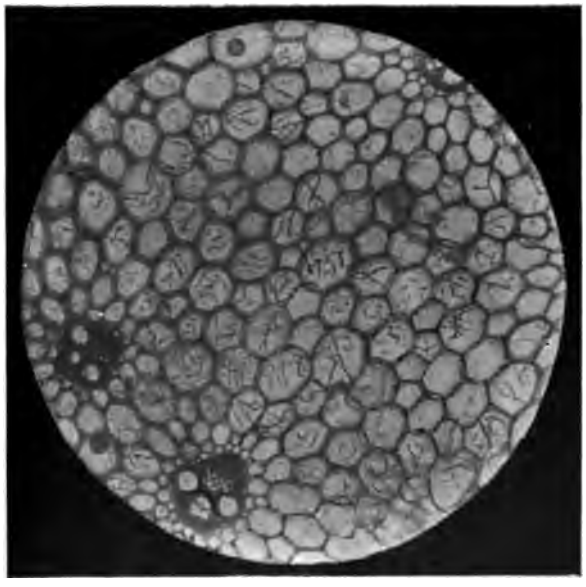
From these remarks cane planters should be able to judge what are the capabilities of this disease, which as

* Diseases of the Sugar Cane, by N. A. Cobb, Dept. of Agriculture, Sydney New South Wales, 1893.

Plate II.



1.—Spores of Cane Spume as seen under the Microscope.



2.—Cross Section of Diseased Cane as seen under the Microscope.
The cells are full of the mycelium of Cane Spume.

'et has not that hold upon their plantations which it ppears to have in New South Wales.

It seems remarkable that a disease of this nature ıould have so peculiar an effect as it has had in the case : Messrs. Townshend's " Poonah " cane. It goes to show ıat, the cane is naturally susceptible to this fungus, ıther than that the fungus has taken on some new ıise.

Naturally the best treatment for spume is the ırning of all trash; for, by this means, the spores hich would otherwise live to propagate the disease are estroyed.

PEACH LEAF CURL.

Exoascus deformans, Fuckel.

Peach Leaf Curl is a fungus disease which was much in evidence last spring, having been observed by the writer from the Coast to the Berg. It is claimed by most authorities that the disease is due to climatic conditions, and that variations in temperature and ıumidity have much to do with its severity. Like the Black Peach Aphis the "Curl" has undoubtedly been more severe during the spring of 1901, and I can ıdvance no better evidence to this effect than the fact hat not a single instance came under my observation in he spring months of 1899 and 1900; though I had been credibly informed of its existence in the Colony for he past ten years, and whenever possible looked for it. Considering the early rains, which accompanied the opening season, and the continued variations of temperature which occurred, from hot sultry days to dull cold ones (all experienced in the course of even a week), it would ıppear that the contention referred to above is reasonably correct.

The disease, however, is not due to climatic conditions, but to a fungus parasite. This is, of itself lone, responsible for the injury done to the tree, but the propagation of the fungus is dependent upon atmospheric conditions, or, in other words, the foliage and new growth of the peach is particularly susceptible while such

conditions prevail, and the more pronounced they are the greater is the attack.

Peach Leaf Curl is a fungus known as *Exoascus deformans*, which has a particularly characteristic effect upon the foliage and new growths of the peach and such other fruits as it attacks. In Natal I have seen it so far upon the peach, plum, and nectarine, but in other parts of the world it has been recorded upon the almond and apricot as well. The popular name of the disease has reference, of course, to the curled and misshapen foliage which follows the attack of the fungus, and which is more or less roughly indicated in the accompanying sketch. The fruit and tender shoots, as well as the

Figure 13.—Peach Twig showing Foliage distorted by the Curl Disease.

foliage, are attacked by the parasite. Soon after the leaves are invaded they assume a thickened and crumpled appearance, due to the damage done to the cells by the fungus. Leaves so attacked do not usually retain their green colour long, but become a rosy pink or yellow hue. Subsequently they become sickly and drop from the tree, particularly when the attack is severe. In mild attacks, however, I have known affected leaves to hang for a considerable time. The blighted twigs also become swollen, distorted and usually curved, whilst the fruit is

blotched and blistered where the fungus has invaded the cells, and usually falls without maturing. The fruit of the nectarine seems more susceptible to attack than that of the peach.

The principal features in the natural history of this pest are easily grasped by the farmer who has some conception of the nature of fungus parasites, a subject which I have already dealt with in my former report and in the *Agricultural Journal*. I will, however, briefly recapitulate some of the more important points applicable to the disease. If a piece of badly diseased foliage be inspected carefully and an examination be made with a magnifying glass, a floury coating will be noticed upon the affected areas, which has the velvety appearance of the bloom on a plum. This is due to the presence of millions of transparent fungus spores, which have burst through the skin of the leaf. These spores are carried about by many agencies, and spread the disease to a great extent, particularly in the early spring. That part of the fungus which lies within the tissue of the leaf, and which produces the spores, is known as the *mycelium*, and may in a general way be likened to the roots of a plant. It is this mycelium, of course, which does the mischief, and, like a number of our native plants which are killed off by the frost of winter, only to start growing from the roots again in the spring, the mycelium has the power of resting over, from season to season, in the wood of its host plant, and of producing a fresh outbreak of disease and a crop of spores in the spring.

The knowledge of this feature has long been in the possession of students, and the opinion was held that this resting mycelium, or root of the fungus in the tissues of the tree, was the principal cause of the appearance of the evil each summer. As a consequence but little hope of freeing a tree from the pest has been entertained by most authorities in writing about it.

Fortunately, however, since the disease has been thoroughly elucidated by Professor Newton Pierce, Pathologist in charge of the Pacific Coast Laboratory of the

United States Department of Agriculture, we are now much better informed, and we know that this is not the case in the majority of instances.

Professor Pierce says that the losses from the disease, amounting to several millions of dollars annually, in the States, together with the obscure views held by many fruit growers, and the total lack of preventive measures, made desirable the work which he carried out. He claims, as the result, that a thorough knowledge of the disease, coupled with preventive measures, will save all this immense amount of loss, and, further, that the disease may be prevented with an ease, certainty, and cheapness rarely attained in the treatment of any serious plant diseases. The conclusions arrived at are based upon an immense amount of evidence. Over 1,600 peach growers were asked to test the treatment recommended, and so much of this experimental work was done by the fruit growers that it resulted in a saving to the country in one year of three-fourths of a million dollars.

The following notes are condensed from Professor Pierce's summary of his work and observations on this disease :—

Peach leaf curl occurs in every region in which the peach is grown. The losses occasioned by it vary from a small amount of fruit to an entire crop, whilst in many instances young trees are killed. The ravages of the fungus are largely dependent upon atmospheric conditions prevailing when the trees are leafing out; and rains and cold weather at that time tend to increase the severity of the trouble by favouring the growth of the parasite and interfering with the proper functions of the peach tree. For these reasons, orchards near large bodies of water, and in low or damp situations, are more subject to curl than those in dry regions or in elevated situations. From careful observations it was also concluded that the outbreak of the disease in the spring is mostly due to the spores of the fungus, and not, as formerly thought, to the perennial mycelium living over through the winter in the twigs of the diseased plant.

TREATMENT.

The proper treatment for peach leaf curl is winter spraying with copper sulphate and lime wash (Bordeaux Mixture). Professor Pierce's experiments showed that, by spraying with this wash from one to two weeks before the opening of the blossoms in spring, 95 to 98 per cent. of the spring foliage was saved. The spraying needs to be continued each season, and the benefit conferred upon the tree is so great that it pays to spray whether a crop is expected from the tree or not. The best results experienced from spraying were obtained by the use of the Bordeaux Mixture prepared from 6lbs. of copper sulphate and 6lbs. quicklime to 45 gallons of water. These proportions must not be used for spraying trees in foliage, otherwise the chemical action will injure the leaves. Bordeaux Mixture, when sprayed upon peach trees in leaf, should not be stronger than 2lbs. of bluestone and 2lbs. of quicklime to 50 gallons of water. At this strength a certain amount of scaling is noticeable, but the damage is immaterial.

POTATO MURRAIN.

Phythpothora (Peronospora) infestans, De Bary.

The potato disease known as "Potato Murrain" (*Peronspora infestans*) is quite a different disease to that so commonly referred to in Natal as "Potato Blight." My attention was first drawn to it in a large field grown from French seed by Mr. Walter Pepworth, M.L.A., at Lidgetton, and I afterwards received samples from Dundee. It is impossible to say whether the disease has existed here before; but it is quite certain that, in these cases, it was introduced with the seed. In this respect the disease differs essentially from the common Potato Blight (*Macrosporium solani*), for it exists in two forms, an active and a passive, the latter being found in the tubers.

This potato disease has been known in Europe for a very considerable period, and has probably existed there

for a century. It was not, however, until 1845 that it assumed a very destructive character in Great Britain. Since that time it has been recognised as a very serious drawback to potato culture; and the spread of the disease throughout Natal will be a deplorable matter indeed.

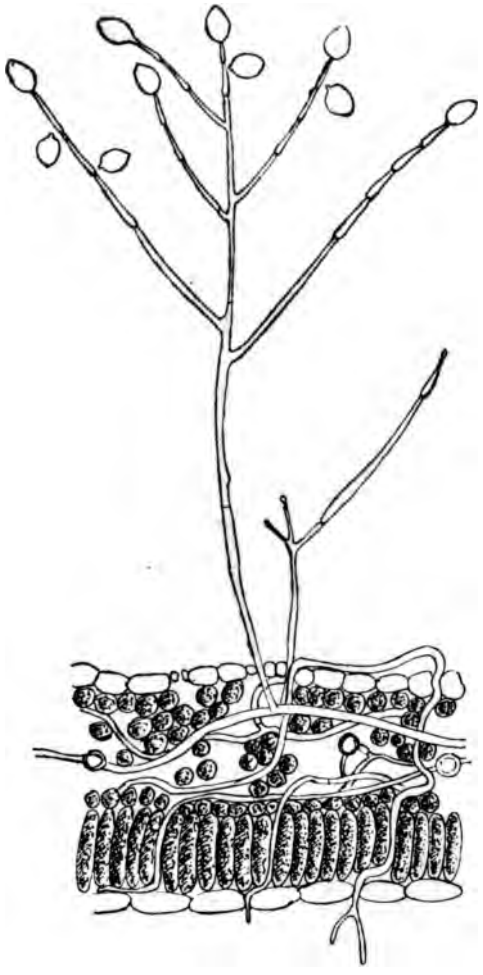
The trouble is characterised by the apparent suddenness with which it attacks a field of potatoes and, also, by the formation of a bloom-like mildew upon the leaves, which is associated with decaying spots. The foliage near the ground is the first part of the plant to show

Figure 14.—Potato leaf attacked by Potato Murrain.

this feature of the attack, and often the disease is first noticed by the death or curling of the leaves. The white bloom, however, is a very distinct feature; and when the plants are quite diseased, it is found over every part.

Like our common Potato Blight and Rust in Forage, "Potato Murrain" is due to a fungus which feeds upon the tissues of the host plant and so destroys it. If a diseased leaf be examined microscopically, the white bloom will be discovered to consist of numberless filament growths bearing minute oval spores, and, upon critical examination, it will be found that these spore-bearing filaments originate from the hyphæ, or roots, of the fungus

ving within the tissue of the leaves and drawing r nourishment from the cells of which the leaf is posed. (See figure 15.)



re 15.—Magnified section through a fragment of potato leaf attacked by otato Murrain, showing the fungus growing in the tissues and fruiting stems emerging through the skin. (After G. W. Smith).

In its active state the fungus is spread about by ns of the oval spores. These oval spores, small as are, contain even smaller spores, and it is these

which carry on the life of the fungus; for, like seeds, they germinate and send forth roots which penetrate the cuticle or skin of the leaves and grow within the tissue. In this state it is the leaves which are generally attacked first, and, from them, the fungus spreads to the stem and stocks and, ultimately, to the tubers also.

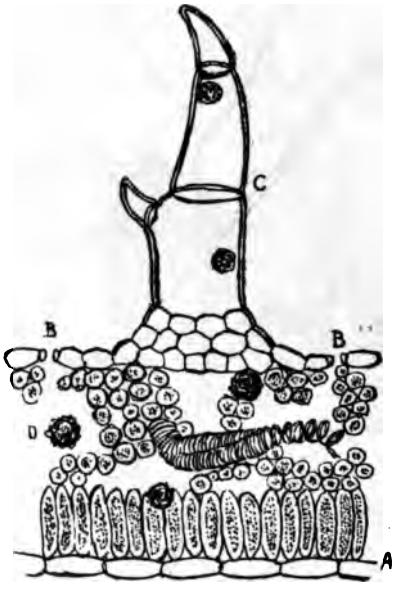
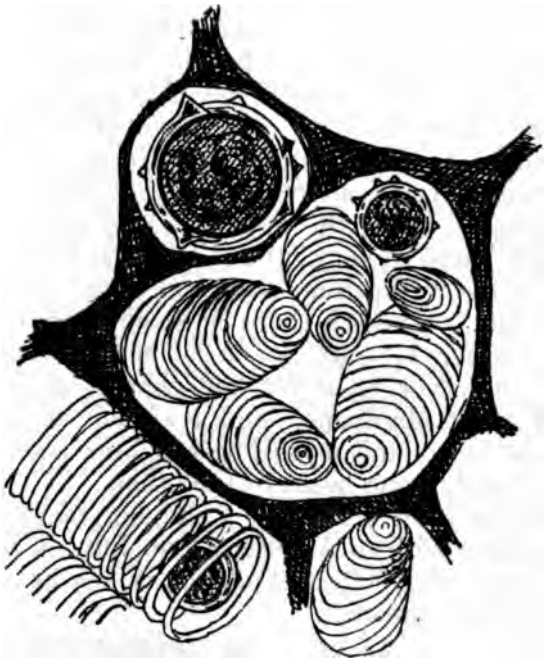


Figure 16.—Section through a fragment of old potato leaf with resting spores D in the tissue, and two in transparent leaf hair. Enlarged 100 diameters. (After G. W. Smith).

In my notes upon "Forage Blight" (*Puccinia coronata*), page 16, first report, I drew attention to a curious habit that fungus had of producing resting spores, and in this respect "Potato Murrain" and Forage Blight agree, for the *Peronospora* also produces resting spores. These spores, however, are found within the tissue of plants destroyed by the fungus, and also within the tissue of the potato-tuber. These few notes, and the illustrations which accompany them, will suffice to give farmers a general idea of the disease, which, as yet, I have naturally not been able to study very thoroughly.

It is needless to say that "Potato Murrain" is a ıst difficult disease to deal with. From a study of its ture and reproductive functions, it is at once clearly ident that fields in which it has already appeared in tal should not be replanted with potatoes for some



igure 17.—Section through a piece of potato tuber, as seen under the microscope, with starch granules and resting spores of Potato Murrain. Magnified 400 diameters. (After G. W. Smith).

ne, unless a very considerable effort has been made clean the field of the dead foliage and decaying tubers. om experience in other countries, I also believe that raying with Bordeaux Mixture will go a good way wards saving a crop.

RUST-RESISTING OATS.

It was hoped that, long ere this, some trial of new varieties of oats would have been made for the purpose of obtaining varieties which would prove rust-resisting and suitable to Natal. Circumstances have not, however, been fortuitous, and the matter is still in abeyance.

Still it is satisfactory to relate that the "Mapstone" oats which were distributed by the Department have, except in a few hands, fulfilled all that was expected of them. The Algerian oats, too, have been proved to possess valuable rust-resisting properties, and further, also, the South American oats grown at Nel's Rust by Mr. J. Baynes. From the general experience, it would appear that there is very little difference between what is known as the "Mapstone" oat and what is known as the "Algerian." Indeed, there is some reason to think that the former is only a more acclimatized form. There are, however, some marked characteristics in the growth of the "Mapstone," and I am not at present in the position to commit myself to a definite statement as to the relationship one bears to the other.

In July last an order for a number of varieties of oats was placed with an American firm, but, owing to the poor oat crop of 1900 in America, it has as yet been impossible to get the oats.

The following is a list of the varieties ordered:—

Texas Red Rust-Proof.	Black Etampes.
Northern Turf.	Houstan's Silver White.
Black Houdan.	Early White Russian.
Tartarian.	Great Northern.
Fenton Rust-Proof.	Race Horse.
Giant Side.	Giant Yellow.
Golden Giant Side.	Kansas Rust-Proof.
Siberian White.	

The ordering of these varieties was consequent upon a number of inquiries made in different parts of the world with reference to the rust-resisting powers of different varieties of oats.

The correspondence upon the subject is very extensive, and contains many features of general interest.

have, therefore, endeavoured to reduce these to a re compact and readable form than they originally ɔeared for the information of Natal farmers. It may as well to point out that all inquiries were made for ;s which would resist the attack of "Crown Rust" *uccinia coronata*), the disease from which oats suffer much in this country. The first inquiries were made September, 1900.

ENGLAND.—From enquiries made in England it was ry evident that no oats there known could be guaranteed resist the ravages of Crown Rust. The Board of griculture, however, intimated that experiments were en being conducted with a view of obtaining a variety oats which would be immune to the attack of the ngus. Several seedsmen recommended a trial of their vn oats, but none would undertake to guarantee as st-resisting even those referred to.

FRANCE.—Very little information was acquired from is country, but a firm recommended the trial of four rieties known as "White Pole," "Yellow Giant," "Grey 'inter," and "Black Northern."

SWEDEN.—It would appear that, in Sweden at least, own Rust very rarely appears in the oats. This is tributed to climatic and local conditions. Under these nditions it is impossible to say how Swedish oats would in Natal.

GERMANY AND HUNGARY.—In these two countries no st-resisting oats are known.

AUSTRALIA.—The replies to our enquiries from the rious states of this Commonwealth are characteristically ke. In New South Wales the experience gained at the ɔvernment farms all showed that the "Algerian" oats d proved to resist the attack of rust better than any ıer. In Victoria the same variety of oats is regarded as e best all-round oats grown there. Of 13 other varieties ;ted, none were found equal to the "Algerian," which ve a return of sixty or more bushels per acre. In these o colonies it is doubtful whether Crown Rust exists, the st spoken of probably being *Puccinia graminis*. Crown ıst does not exist in South Australia, and the authorities ɛre consider it highly improbable that any of their

varieties of oats would resist the disease if grown in Natal. In Queensland, oats are chiefly grown for hay, as with us in Natal, and there the favourite varieties are "Algerian," "White Tartarian," and "Black Tartarian."

NEW ZEALAND.—"Tartarian" and "Sparrowbill" are reported to be entirely free from the attack of rust in New Zealand; but, at the same time, it is said that rust in oats is very seldom met with there.

CANADA.—A large number of oats have been tested at the Dominion Experimental Farms, but none of these were found to be entirely free from rust. Some varieties, however, were proved to be less subject to rust than others, and amongst those least affected were "Banner" and "Bavarian."

ARGENTINE REPUBLIC.—In this country all oats are said to be attacked by Crown Rust. No studies have been made, however, upon the subject of rust-resistency, owing to the limited production of the cereal.

INDIA.—The cultivation of oats is confined to a very small portion of Northern India, and the total area upon which oats are grown for grain barely exceeds 15,000 acres. The crop there is, as a rule, cut for fodder. No rust-resisting varieties have been specially grown, nor are there any complaints of the attack of this parasite in that area in which oats are grown.

JAPAN.—In Japan oats are grown wild only. In the northern part of the country small lots are cultivated, but these are raised from European or American seed, which has to be renewed every year.

EGYPT.—There appears to be no variety of oats with any claims to rust-resistancy in Egypt. All imported oats fail owing to rust, and English varieties suffer more there than in England. There are three wild varieties, but none are cultivated.

UNITED STATES OF AMERICA.—Of all the information supplied, that from the United States certainly proves the most encouraging. According to information supplied by the Department of Agriculture at Washington, comparatively little has been done in the United States with reference to testing the resistancy of oats to the disease in question; and it appears, from evidence collected, that the

"black stem-rust" is far more destructive than the crown rust. In the southern portions of the States "Texas Rust-Proof" oat has been considered resistant to the latter, although it has not proved so in the north. In Minnesota the following varieties have been found to be resistant to the fungus:—

Northern Turf.	Black Houdan.
Siberian White.	Houstan's Silver White.
Black Etampes.	

Reports from Kansas state briefly that the State Board of Agriculture there is not familiar with any rust-resisting oats being grown in Kansas or elsewhere.

In Missouri the variety of oats known as "Texas Red Rust-Proof" is said to have been found very productive and hardy, possessing unusual ability to stand up. This oat possesses a large grain covered with a large husk. It, however, has not been tested for rust-resistancy.

From Texas, information supplied is to the effect that what is known upon the Western market as the "Kansas Rust-proof Oat" resists the rust more effectually when grown from locally-raised seed, and the oats will produce crops upon lands of low altitude, with close impervious subsoil, when other varieties will succumb completely to the rust.

LUCERNE DODDER.

Cuscuta, sp.

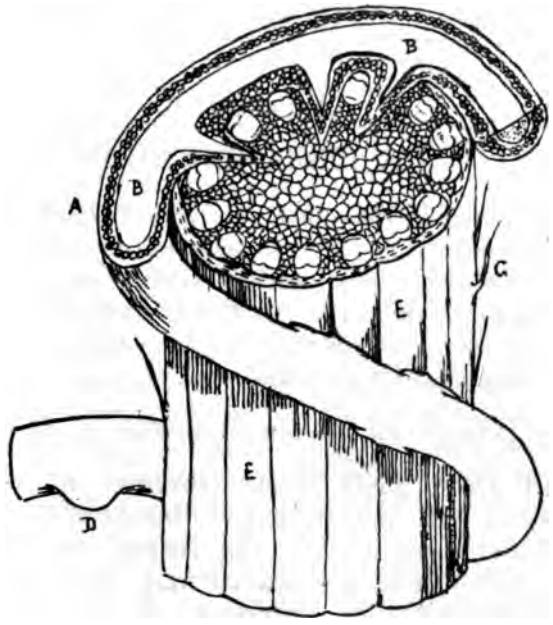
Lucerne Dodder is a plant parasite somewhat of the nature of the "witchweed" or "Isona" described in my last report, see page 20. It, however, differs in being an aerial rather than a subterranean parasite, and, in this respect, may be likened somewhat to the mistletoe. There are several different dodders, and these are, generally speaking, found as parasites of the clover family; though a great variety of other plants are said to be affected. Of these flax, thyme, broom, heath, furze, cabbage, nettles, hops, cranberry, thistles, tomatoes and vines may be mentioned. In all cases the attack is the same. In many

into the soil, as is usual with other plants; but into the air in search of a host-plant upon which to engraft themselves and live as parasites.

The seed of the dodder is produced upon the leafless stems, which bear small white flowers, closely packed clusters or rosettes, and these were present upon the sample sent me from Zululand. No seeds were, however, noticed, but, owing to the climate, they will no doubt be produced.

Figure 22 —Young Dodder Plant upon Lucerne Leaf, enlarged 10 diametres. (After G. W. Smith.)

They are about one-third the size of a red clover seed, of a brown colour, and covered with minute granulations, and in this respect differ from lucerne and clover seeds, which are smooth and shiny. Dodder seeds do not germinate as quickly as the seeds of the host-plants. That their germination should be delayed is necessary so that they find the host-plant ready for attack. Dodder rapidly spreads in the field, as the lucerne grows, by the aid of the long thread-like branches which it throws out. As it kills its host it naturally spreads in a circle from the centre of attack; it leaves dead patches in the fields, so that, in this respect also, it resembles the case of witch-weed attack mentioned in discussing that pest last year.



ure 23.—Cross section through piece of Lucerne at point of attachment of Dodder stem to show the connection of the Dodder by suckers. The suckers of the Dodder are pushed into the fine longitudinal furrows of the Lucerne, E. E. These reach the central pith as shown in the cross section, B. B. being a section of the Dodder entwining the Lucerne. (Enlarged 15 diametres, after G. W. Smith.)

Treatment.

The simplest and only treatment for dodder is to get . of it. Where it has broken out in a field, the attacked erne and that in a circle around it should be cut very sely and carefully removed and burned. Everything pends upon thoroughly removing and destroying the ected plants.

However, prevention is better than cure, and there- e great care must be exercised in the purchase of lucerne d so as to obtain it pure. Dodder seed can be removed m lucerne seed by careful sieving, and seed merchants repute can generally be relied upon for pure seed. nsequently, it is always desirable to deal with a firm ich does a large seed business and cannot afford to lose reputation.

Appendix A.

A PROPOSED BILL.

To check the introduction of Insect Pests and Plant Diseases from places without the Colony and to prevent their dissemination from Nurseries of Plants and Trees and from Orchards and Gardens and the like and to provide for their eradication within the Colony and its Dependencies.

To be introduced by the Minister of Agriculture.

ommencement BE IT ENACTED by the Governor of the Colony of Natal, with the advice and consent of the Legislative Council and House of Assembly thereof, as follows:—

1. So much of any law as may be repugnant to or inconsistent with the provisions of this Act is hereby repealed.

hort title. 2. This Act may be cited as "The Insect Pests and Plant Diseases Act of 1902."

nterpretation. 3. For the purposes of this Act the following terms within inverted commas, if not inconsistent with the context and subject matter, have the meanings hereby respectively assigned to them, that is to say:—

"Insect Pest" shall signify any insect which the Governor may, from time to time by Proclamation, declare to be an Insect Pest within the meaning of this Act.

"Plant Disease" shall mean any fungoid or other disease which the Governor may, from time to time by Proclamation, declare to be a Plant Disease within the meaning of this Act.

"Nursery" shall mean any land or premises whereon are grown or cultivated any fruit or other trees, shrubs or plants intended for sale or distribution for the purpose of being grown elsewhere, and extends to and includes any adjacent orchard, garden or vinery.

"Orchard" shall mean any land or premises used for the purpose of growing or cultivating fruit-bearing plants, and extends to and includes garden, vinery or vineyard.

"Plantation" shall mean any parcel of land planted with trees or other vegetation for commercial or ornamental purposes.

"Plant" shall mean any tree, shrub or vegetation, or any part or product thereof, including the fruit, whether severed or attached.

"Minister" shall mean the Minister of Agriculture.

"Inspector" shall mean any person appointed as Inspector under this Act by the Minister.

"Occupier" shall mean the person in actual occupation of any land, or if there is no such person, then the person entitled to the possession thereof.

"Owner" shall mean the person other than His Majesty who is for the time being entitled to receive the rent of any parcel of land, or who, if the same were let to a tenant at a rack-rent, would be entitled to receive such rack-rent.

"Place of Entry" shall mean the Port of Natal and such other places as may be approved by the Minister.

"Regulations" shall mean any regulation made under this Act.

Board of Advice.

4. The Minister may from time to time appoint an rary Board of Advice, consisting of five or seven bers, of whom at least two shall be officers of the rtment of Agriculture and the others representative -farmers and nurserymen.

Such Board of Advice to exist at the pleasure of the ster, and the members thereof to receive no fee or rd for their services save only travelling expenses.

functions of the Board to include advising the ster with regard to:—

(*a*) Prohibiting or restricting the importation of plants, and their removal within the Colony from place to place.

(*b*) The framing of rules and regulations under this Act.

(*c*) What pests and diseases shall be brought under the provisions of this Act, and regarding the administering of the Act generally.

Proclamation,

5. By proclamation the Governor may from time to time make, alter and revoke such rules and regulations as may be deemed expedient for the purpose of carrying out the provisions of this Act, that is to say:—

Rules and Regulations.

(*a*) Prescribing the conditions under which plants, products, or parts thereof, etc., may be introduced into the Colony of Natal.

(*b*) Prohibiting the introduction into the Colony generally, or from any specified place, of any or every plant or part or product thereof, which is considered likely to introduce any insect pest or plant disease.

(*c*) Providing for the payment of registration and other fees.

(*d*) Provide for the destruction or isolation and treatment of any plant infested with what may be deemed a pest or disease inimicable to the interests of the community, and for the fumigation of nursery stock before delivery.

(*e*) And generally for any other purpose for which regulations are contemplated by this Act or which may be deemed necessary in order to give full effect to it.

Proclamations to be published and laid before Parliament.

6. Every Proclamation issued under this Act shall be published in the *Natal Government Gazette*, and from and after the publication of any such proclamation it shall have the full force of law.

And every such Proclamation shall be laid before both Houses of Parliament within fourteen days after the publication thereof, if Parliament is then sitting, and, if not, within fourteen days after the next assembling of Parliament.

Registration of Nurseries.

7. Every nursery shall be registered by the owner or occupier thereof, at the office of the Magistrate of the district wherein such nursery is located, on or before the 31st day of January in each year; and a general registra-

a fee of £1 per annum shall be paid by the owner or :upier in respect of any nurseries owned or occupied by n in such district.

Inspection of Nurseries.

8. Every nursery shall be inspected at least twice a :ar by a competent officer appointed by the Minister.

Inspection of Orchards and Plantations.

9. The Governor may at any time or from time to me order by Proclamation an inspection of the orchards id plantations of the whole Colony, or of any part ierof, and invest in Inspectors under this Act such powers i are prescribed for them.

Appointment of Inspectors.

10. The Minister may appoint an Entomologist as hief Inspector under this Act, and from time to time such fficers of the Customs and other persons as may be deemed ecessary to be inspectors under this Act, and may from me to time remove or dismiss any inspector.

The Minister may also provide for the remuneration f any inspectors under this Act out of any moneys ppropriated by Parliament for that purpose.

The production of a written authority signed by the Minister shall be sufficient evidence of the appointment of ny person as inspector under this Act.

Powers of Inspectors.

11. Every inspector may seize and detain any plant or part thereof which is suspected to be diseased and which s being imported or introduced into Natal, and may remove, examine, disinfect or destroy the same, together with any box, basket or package in which such diseased plant or part thereof has been packed.

Every inspector may, with or without notice and with or without assistants, enter at all reasonable times upon any nursery or orchard for the purposes of inspection and may remain thereon so long as may be reasonably necessary for such purpose, and any person obstructing, resisting or interfering with any such inspector in the lawful execution of his duty shall be deemed to be guilty of a contravention of this Act.

Duties of Inspectors.

12. It shall be the duty of the inspector to direct in writing the occupier or owner of such nursery or orchard to take, within a definite time, all such measures for the eradication of such pests or disease as shall in his opinion be necessary, and declare under quarantine any land or such part thereof as may deem advisable to him. All

action taken under this section must be reported to the Minister for confirmation as soon as possible thereafter in accordance with Section 18 of this Act.

Destruction of plants by Inspectors.

13. It shall also be the duty of any inspector to order and cause to be carried into effect the destruction of any plant when in his opinion it is affected by such Insect Pest or Plant Disease as cannot be eradicated otherwise and when he deems such action advisable; provided, however, that any dispute as to the justification of such a measure shall be referred for decision to the Minister, whose decision shall be final.

Non-liability of Inspectors and others.

14. No inspector, and no person acting under the direction or order of such inspector, shall be deemed to be a trespasser by reason of any entry or destruction under this Act, or be liable for any damages occasioned by carrying out the provisions of this Act unless the same were occasioned maliciously.

Limitations of actions.

15. No action shall be brought against any person for anything done by him in pursuance of any authority conferred by or under this Act unless the same be commenced within four months after the thing complained of shall be done.

Compensation.

16. No person shall be entitled to receive any compensation whatsoever in consequence of any measures lawfully taken under the provisions of this Act, but it shall be within the discretion of the Minister to direct the payment of whatsoever compensation he may determine in the event of any trees or shrubs, not suffering from any Insect Pest or Plant Disease, being destroyed for the purpose of preventing the spread of any Insect Pest or Plant Disease of a virulent character.

Fumigation of Nursery Stock.

17. All owners or occupiers of nurseries shall provide proper chambers for fumigating with Hydrocyanic Acid Gas, and they shall fumigate all fruit trees and ornamental trees and shrubs immediately prior to delivery, in accordance with such regulations as may be framed for this purpose.

Quarantine of Nurseries, Orchards and Plantations.

18. Any inspector may, with the approval of the Minister, declare under quarantine any nursery, orchard or plantation or adjoining lands, or any such part thereof as he may deem expedient in order to prevent the dis-

ination therefrom of any Insect Pests or Plant Disease, the Minister may revoke or renew such quarantine n time to time.

Quarantine of Nurseries, &c.

19. In the event of any such quarantine being ɔosed, the following provisions shall apply :—

(*a*) The Minister may, by notice published in the *Agricultural Journal* and the *Government Gazette*, describe with reasonable particularity the situation and area of the land to which such quarantine relates.

(*b*) Until the revocation of such notice such land shall be deemed an infected area from which no plant or part thereof or fruit shall be removed except under the direction of an inspector, and within which the occupier shall do all such things as are deemed necessary in order to eradicate or prevent the spread of the disease.

(*c*) Any such notice may be revoked by notice in the *Government Gazette* and *Agricultural Journal*.

Penalties.

20. Every person shall be guilty of an offence against s Act who—

(*a*) In any manner obstructs or impedes any person in the execution of any of the powers conferred by this Act ; or

(*b*) Disobeys or neglects to comply with any of the provisions of this Act, or the terms of any Proclamation issued thereunder, or any regulations or rules, or any order given in pursuance thereof respectively.

21. All persons contravening this Act, or any regula- ı made thereunder, shall be liable to a penalty not ex- ling twenty pounds (£20) sterling, to be recovered in court of a magistrate by the inspector or any proper ɔer of the department.

Expenses of Act.

22. All expenses incurred in the administration of s Act shall be paid out of moneys to be appropriated by liament for that purpose.

Appendix B.

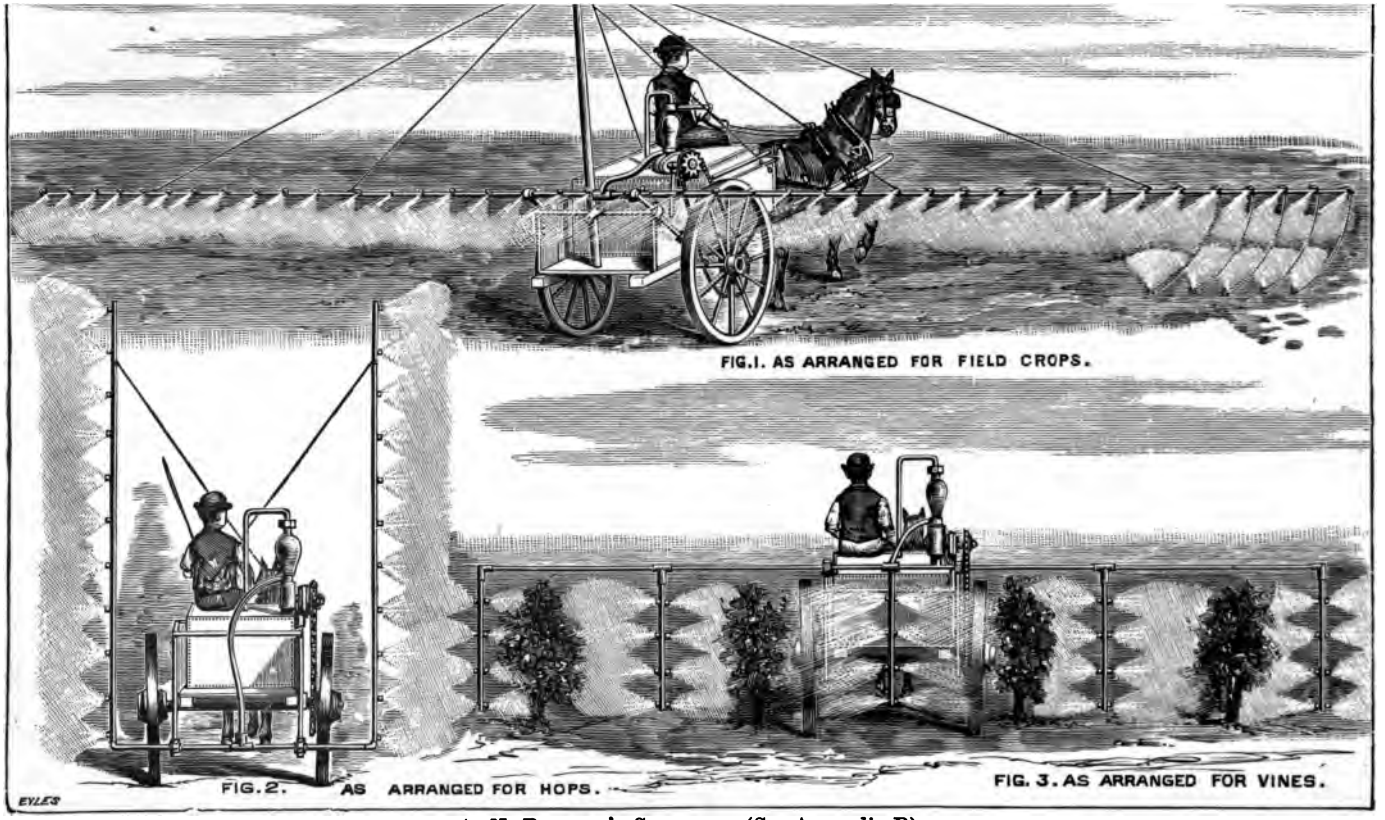
A. N. PEARSON'S SPRAYER.

[*Extracted from Part II., Handbook of the Destructive Insects of Victoria, by Charles French.*]

A spraying arrangement (see Figs. 1, 2, and 3) which will operate in a wholesale manner has recently been invented by Mr. A. N. Pearson, Government Agricultural Chemist (now Director of Agriculture, Natal), in connection primarily with the work of the Intercolonial Rust in Wheat Conference.

From the drawing it will be seen that the arrangement consists of an iron tank (or other suitable vessel), placed in an ordinary cart; attached to the top of this tank is a pump (either rotatory or double-acting piston pump), which is operated by means of chain gearing and spoke clamps on the cart wheel. This pump, when the cart is in motion, draws the liquid out of the tank and forces it into a long pipe or system of pipes bearing a number of atomizing nozzles, through which the liquid is ejected in a fine spray.

The invention consists principally in the use, arrangement and manner of support of the long pipe or system of pipes. The pipe is made in sections, which can be screwed together in a variety of ways. In Fig. 1 all the sections are arranged in the form of a long horizontal pipe 50 feet in length, supported, firstly, by two standards clamped on to the sides of the cart, and, secondly, by a short mast with tie wires. Other tie wires, suitably disposed, can be added when required to prevent horizontal swaying of the pipe. The two standards can, within certain limits, be clamped to the sides of the cart in any desired position, so



A. N. Pearson's Sprayer. (See Appendix B).

that the long pipe can be placed any distance between 3 inches and 10 feet above ground. In addition to, or instead of, the nozzles attached directly to the pipe, there can be attached a number of thin, backwardly curving branch pipes, as shown at the right hand in Fig. 1. These branch pipes deliver the spray on the under surface of the leaves of ground crops, such as potatoes, and right in the interior of cereal crops, such as barley attacked by caterpillars, or wheat attacked by rust. Fig. 2 shows the sprayer arranged for spraying hops, and Fig. 3 for spraying vines, five rows at a time. The pipes may be similarly arranged for spraying fruit trees in an orchard.

The advantage of this machine is in the large area of ground that can be covered in a short time. Thus, a pipe 50 feet long, the sprayer moving at the rate of $2\frac{1}{2}$ miles an hour, would cover more than 15 acres an hour, or say 160 a day of twelve hours, allowing for refilling.

The tank is filled by disconnecting the pump from its chain gearing, inserting the india-rubber hose into the well or cistern containing the water or prepared solution, and working the pump by hand backwards way. On referring to the drawings, a pipe furnished with a cock will be seen leading from the top of the pump back again into the tank. The pipe serves a double purpose: 1st, it acts as a stirrer, for any liquid forced through it will stir up the liquid or emulsion in the tank; 2nd, it serves to adjust the amount of liquid to be delivered as a spray, for it will be readily understood that the more liquid is allowed pass through the pipe the less will pass through the nozzles. Further adjustment can also be made by placing the spoke clamps on the cart further from, or nearer to, the centre, so that the gearing chain works from a greater or less circle, and therefore at greater or less speed. A strainer is fixed on to the end of the feed pipe of the pump to prevent the entrance of particles which would stop up the nozzles.

The same system of piping can be adapted to the use of steam spraying, a small steam boiler being then placed in the cart instead of the tank, pump and chain gearing.

The chief advantage claimed for this sprayer is the rapidity and wholesale manner of its operation. A

machine which will cover 15 acres in one hour makes the cost of spraying little more than nominal. Another advantage is that it does next to no damage to the crop. The only damage done is by the cart wheels and the feet of the horses, which in a track of 50 feet in width cannot amount to more than one or two per cent.

This sprayer is extremely simple in construction; an ordinary cart is all that is required to carry it, and the pump can be used for other purposes when detached from the tank.

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FOURTH REPORT

OF THE

Government Entomologist.

Department of Entomology,
2nd November, 1904.

LETTER OF SUBMITTAL.

The Honourable
Minister of Agriculture.

Sir,—I have the honour to submit a report, together with notes and observations coming within the range of work of the department under my direction, covering a period of eighteen months, *i.e.*, from 1st January, 1903, to 30th June, 1904. Pressure of other matters has prevented an earlier submittal, and advantage has been taken to include some observations on life-histories of two important pests, the Mediterranean Fruit Fly and the Fig Curculio, made since June.

The report of the Chief Locust Officer for the Locust Campaign 1903-04 will be submitted separately.

Respectfully submitted,

CLAUDE FULLER,
Government Entomologist.

INTRODUCTION.

This is the fourth report which I have had the honour to s upon my work in Natal. The first report, it will be remem covered a period of 16 months (August, 1899, to December 1900). This was of a comprehensive nature, and dealt with a ber of insects and fungus pests which had been met with. second report, covering the year 1901, contained, in a meas supplement to the first. In these two reports some account was of 62 insects and 23 plant diseases of a more or less destru nature. My third report, covering the year 1902, was in n so comprehensive, covering merely the routine work of the ye

It has been thought advisable to reduce the comprehensiv of this report also, but the opportunity is taken to allude in son tail to one or two pests. As indicated later, under notes and ob tions, there has, during the period covered by this report, b large amount of matter accumulated which might be review length. This is such, however, that it is preferable to delay in that the records made may be qualified by a further series c servations being conducted during the ensuing season 1904-5.

In my third report I took the opportunity of emphasising desirability of rendering reports covering what is known in Nat the Financial Year, *i.e.*, July to June, so bringing the reports line with those emanating from countries in the Northern H phere, which being rendered for the calender year include the v of the summer season, and my reasons for the convenience of an arrangement were therein indicated. I am glad to say tha suggestion has now been adopted, and the present report cov period of eighteen months, January, 1903, to June, 1904.

GENERAL.

In my third report I had occasion to point out that the stock of my first and second reports was practically exhausted. two earlier reports contained a good deal of information conce a variety of pests and their treatment. Altogether sixty-two " pests" and twenty-three fungi or plant troubles were reported From my own point of view the reports were very incomplet the illustrations, on the whole, very poor. I must admit, hov that in the hands of many they have proved very useful, an copies are constantly being asked for, something to replace th very desirable. Furthermore, in view of the passing into law Plant Diseases Bill mentioned in two former reports, it is essential that every fruit-grower should have in his possessi much reliable information as possible concerning insect and f pests and their most economic treatment. I, therefore, prop prepare at once a handbook upon these matters, and trust that

of money sufficient to defray the expenses of publication will be placed upon the Estimates for the year 1904-5.

The text of the Plant Diseases Act to which allusion has just been made is appended (Appendix A.), and it is a matter of congratulation to the Colony. The powers which this Statute confers upon the Government can be successfully used to stamp out many new pests of fruit and fruit trees which may from time to time gain a foothold in Natal. That such powers are necessary is evidenced by the fact that within the last year two new scale insests (described later) have been introduced and are as yet only located in one or two orchards.

OFFICE WORK.

This work, which includes the rearing of specimens and their preparation, besides correspondence and other details, has been altogether unsatisfactory owing to the want of more assistance. I have to acknowledge again the work of Mr. Kelly, who has deported himself well and given many indications of improvement. To him has fallen a large share of fumigation work both in houses and in the field, which is very creditable to one so young. The appointment of Mr. Berensberg to assist in life-history work and field operations is very hopeful. He is an entomologist and artist of no mean ability, and has a good experience of South African insects, which cannot fail to be of much value. The increase of work consequent upon the Pest Disease Act and the Burr Weed Act will necessitate extra assistance in the near future.

CORRESPONDENCE AND PUBLICATIONS.

During the year 1903, 478 letters were despatched and recorded, and for the first six months of 1904 about 200. These figures could be increased if every letter sent out was recorded, but this is not always necessary. Compared with previous years, there is a slight falling off in the correspondence, but the standard is not low. Superficially it does not compare favourably with that of similar divisions. Thus, for instance, the Victorian Entomologist in his last report mentions that he despatched 4,283 letters, and in 1901 the Cape Entomologist records over 700. Since its inception the average from this office has been 500 per annum, or a little more than 500 per 100,000 white population. On the same basis the Victorian record would be 376 per 100,000, and the Cape 140 per 100,000. So that upon the whole the correspondence may be considered satisfactory, particularly as it is exclusive of all in connection with locust destruction.

Numerous official reports and minutes of some importance and requiring consideration have also been prepared, but of these no record has been kept.

Below is a tabulated list of contributions to the *Agricult Journal.* Here it may not be out of place to congratulate the De ment upon the much-desired change in the shape and get-up of organ, and to express the hope that this mechanical improveme but the index of better things to come.

TITLE.	FORM.	ISSUE.	PAGES.
		1903	
Plant Enemies of Plants ...	Lecture	9 Jan. ...	Vol. VI, 41-4
Mabele Aphis	Notes	20 Feb. ...	,, 127-8
Coast Fruit Culture	Lecture	20 ,, ...	,, 118-1
Collar Rot of Orange Trees ...	Notes	6 March	,, 150-1
Mabele Aphis (J. G. Fannin) ...	,, ...	20 ,,	,, 173
Turnip and Cabbage Aphis	Note	1 May ...	,, 295-6
The Cape Regulations for the Import of Fruit Trees, etc. ...	Correspondence	1 ,, ...	,, 320-3
Mabele Aphis	Notes	26 June ...	,, 337-3
Locust Destruction	Report	24 July ...	,, 457-4
Rhodesian Redwater	,, ...	16 Oct. ...	,, 695-6
		1904	
Mosquitoes	Letter	January ...	Vol. VII., 50-4
Mealie Grubs	,, ...	February	,, 121
Woolly Aphis	,, ...	March ...	,, 241
Black Spot of Peach	,, ...	April ...	,, 35[illegible]

ITINERARY.

During the past eighteen months 45 visits were paid to undermentioned centres. This entailed journeyings by rail and of 6,429 miles, and occupied over 130 days, or nearly a third of period specified.

DATE.	LOCALITY.	PURPOSE.	REMARKS.
1903			
Jan. 9	Cedara	Potato Spraying ...	
,, 14-17	Tugela Water Furrow	Inspection of Native Crops under Irrigation	Went *via* Greytown Muden. Interesting servations made.
,, 26	Nel's Rust Rail...	Orchard advice... ...	Instructions in pruning
,, 28	Balgowan ...	To secure Spraying Machinery	
Feb. 3-4	Dalton	Farm Visit	Observations on various and advice given.
,, 9-14	Nth. Coast Dists.	Observations in connection with Outbreak of Amabele Aphis	
,, 21-26	Sth. ,, ,,		
Mar. 5	Cedara	Potato Spraying ...	
,, 9	Town Bush Val.	Orange ,, ...	
,, 16	Cedara	Potato ,, ...	
,, 21	Nottingham Road	Orchard advice ...	
,, 25	Town Bush Val.	Spraying Experiments	
Apl. 1-5	Himeville ...	Agric. Show visited ...	By invitation. Sever servations of interest

DATE.	LOCALITY.	PURPOSE.	REMARKS.
1903			
pl. 8	Cedara	Potato Spraying ...	
„ 21-23	Durban County	Orchard advice ...	
„ 12	Cedara	Potato Spraying ...	
„ 19	„	„ „ ...	
une 8-11	Northdene and Chaka's Kraal	Observations on Mabele Aphis	
„ 18-19	Agric. Soc.'s Show	As Steward	
ly. 15-16	Ladysmith „	As Exhibitor ...	
ep. 15-19	Nth. Coast Dists.	Orchard advice	Farms visited by request.
„ 30	Town Bush Val.	Observations	
ct. 5-9	North Shepstone	Orchard advice	
„ 13-18	Stanger	Lecture	
„ 20-23	Ixopo, Thornville	2 Lectures	
„ 25-26	Nottingham Road	Lecture	
ec. 2-10	Boston, Bulwer and South Coast	2 Lectures; Locust Observations	With Transvaal Entomologist
„ 30	Noodsberg Road	Lecture	
„ 12-13	Richmond ...	„	
„ 15-25	Bergville, Dumisa, Ladysmith	2 Lectures; Field advice and Observations	
1904			
an. 15-16	Greytown ...	Lecture	
„ 18	New Hanover ...	„	
eb. 1-11	Stanger, Verulam	2 Lectures	
	Umzinto, Port Shepstone	„	
„ 15	Durban	Observations	
„ 19	Howick	Lecture	
„ 23-25	Ladysmith ...	„	
ar. 16	Town Bush Val.	Citrus Fumigating ...	
„ 22	„ „	„ „ ...	
pl. 6-14	Pretoria ... " ...	Conference of Entomologists	
„ 16-17	Hillcrest	Orchard Valuation ...	
„ 25	Manderston ...	„ Advice ...	
„ 28	Town Bush Val.	Observations	
„ 17	Chase Valley ..	Orchard advice	
une 2-4	Stanger	Agric. Show as Judge	
„ 10-11	Nottingham Road	Orchard advice	

LECTURES.

The only lecture prepared was that entitled "Insects in an Important Role." This was a purely popular lecture compiled to meet the exigencies of the moment. It was first read before the Farmers' Conference on 21st October, 1903, and subsequently at the following centres:—Ixopo, Thornville Junction, Nottingham Road, Noodsberg Road, Boston, Bulwer, Bergville, Dundee, Richmond, Greytown, New Hanover, Stanger, Verulam, Umzinto, Port Shepstone, Howick and Ladysmith.

The lecture has since appeared in pamphlet form and been distributed, as suggested at the Farmers' Conference, amongst the members of the various agricultural and farmers' associations.

ECONOMIC ENTOMOLOGY.

Since my last report was written two new entomologists have entered the South African field. Mr. C. B. Simpson has been appointed Entomologist to the Transvaal and Mr. W. R. Dewar to the Orange River Colony. Their arrival is most welcome, and the cordial co-operation of this office is extended to them. Furthermore, Mr. Mally, for some time under Mr. Lounsbury at Capetown, has been transferred to Grahamstown as Entomologist to the Eastern Province of Cape Colony.

During November last year Mr. Simpson paid Natal a short visit. This happened at rather an unfortunte time, for not only was the weather unpropitious, but I was then busy on my lecture tour. However, I was able to take Mr. Simpson to a few centres of interest. He visited Boston, Bulwer, New Hanover and Port Shepstone with me, and also had the opportunity of seeing some of the nurseries of Maritzburg and Durban.

In April last I was summoned to Pretoria to attend a conference of Economic Entomologists and Horticulturists held under the auspices of the Department of Agriculture there. The conference extended over two days, and the delegates also had the opportunity of visiting several places of interest, amongst which I may mention the Botanists Field Station near Pretoria, the Veterinary Laboratory, Mr. S. Mark's Fruit Plantation at Eerste Fabrieke, and Mr. Nelson's large Nursery at Johannesburg.

FORESTRY.

Under this heading I gave, in my 1902 report, some account of a trip to Cape Colony in March of that year. I would not again allude to the subject were it not that a prominent public writer, who presumably voices the opinion of the farming community, has thought fit to comment somewhat unkindly thereupon. If my memory serves me aright, it was questioned—1, whether that report was worth the paper upon which it appeared; and 2, whether my time had not been better spent in Natal than in a trip to Cape Colony.

With regard to the first point, it would not be out of place to say that the value of the report is best judged by its direct results. These were—1, the appropriation of sufficient money to establish a Forestry Department in Natal; 2, the visit of Mr. Storr-Lister, and 3, the appointment of a Conservator of Forests. My critic had, of course, lost sight of the fact that the matter, though delayed in the press until 1903, was submitted early in 1902, and, as it appeared, was only an account of my observations from which the specific recommendations accompanying it (all of which were adopted by the last Minister of Agriculture) were properly eliminated.

The second point is so typical of the lop-sided criticism of public officials so often indulged in by prejudiced parties that it calls for no further comment from me.

PORT EXAMINATIONS.

Proclamation No. 37, 1900.

The examination of fresh fruit, trees and plants and their treatat the Port is still being conducted on my behalf by Mr. C. B. , and his returns are regularly published in the *Agricultural al.* A complete return for the 18 months is appended, and ion is drawn to the large quantities of fresh fruit, and fruit and ental plants which are entering the Colony. Altogether 269 fruit trees are given in the returns. This does not sound very , but some of this lots are made up of several thousand trees, have ascertained that in the two months of this year, June and the invoice value of fruit trees landed from Australia was 5.

Under present arrangements all fruit trees, whether found in- with insect pests or not, are fumigated. This, together with pid increase of imported trees, has necessitated the building of fumigation house, which will presently come into use. This ure is of a permanent nature, and is considerably larger and appointed than the old temporary shed which, during its few of existence, went through many vicissitudes. Indeed, on one on it was spirited away for several days, but was fortunately ered in time and re-erected on a second temporary site.

With regard to these Port examinations and the treatment of I am bound to say that, whilst I have the greatest confidence e gentleman superintending the work, it would be more satisy to me if I were in closer touch with the Point. With a dis- of seventy miles intervening, this is, however, impracticable, fear the advisability of establishing a branch of this office at an will have to be presently considered.

RETURNS.

CLASS.	Jan.-Dec., 1903.	Jan.-June, 1904.	Total for 18 Months.
s	26,730 cases	6,767 cases	33,497 cases
... ...	17 „	100 „	117 „
ges and Lemons ...	4,212 „	2,383 „	6,595 „
s	1,231 „	118 „	1,349 „
pples...	16 „	—	16 „
s	—	185 cases	185 „
oes	—	1 „	1 „
r Melons	—	13 „	13 „
Fruit (Miscellanecus) ...	2,323 cases	99 „	2,422 „
Trees	205 lots	64 lots	269 lots
ental Plants	90 „	187 „	277 „
Potatoes	51,756 cases	8,077 cases	59,833 cases
Potatoes	24,201 „	8,850 „	33,051 „
s	2,235 „	—	2,235 „
toes	20 „	—	20 „

The list of insects infesting imported fruit is very short. Aphides have been found on strawberries and on roses, and commonly occur on ornamental plants. Mediterranean oranges and lemons are not uncommonly attacked by *Mytilaspis citricola* and *Parlatoria pergandei*, and several consignments infested with the latter have been destroyed. It is unfortunate, however, to report that this pest has gained a foothold in the Colony; it is described later in this report. Several shipments of apples which have been attacked by Codling Moth have been refused entry into the Colony. Some lots of Tasmanian apples attacked by Fusicladium have been passed, as they are usually consumed in the townships. It is a question, however, whether fruit suffering from this disease should be allowed entry, and in all probability it will soon be necessary to prohibit the distribution of any apples so affected.

THE NATAL CODLING MOTH.

Carpocapsa sp.

This insect still maintains its position as a serious pest. It has been again observed in peaches and in the small red China guavas, but it is particularly harmful to oranges and mandarines, and its only serious aspect is where it infests these fruits. There is no doubt that much success attends the removal and destruction of infested fruit, and a number of growers attend to this most conscientiously. They have, however, a serious drawback in the form of neighbours who do not care, nor do anything. These cases of indifference will necessarily have to be dealt with under the new law relating to orchard pests. This insect is one which must be kept under control in closely settled areas, such as those around Maritzburg, not alone because it does such great mischief, but also because its prevalence in local citrus fruit will seriously affect the facilities of export to our neighbouring Colonies. Furthermore, in the case of shipments having to travel any distance, one affected orange, rapidly decaying, would seriously deteriorate those picked with it.

It has not been possible to give much further attention to the life-cycle and habits of this pest, because it is impracticable, under present circumstances, to give everything the attention it requires. It is hoped that a good deal will be done now that I have some technical assistance; and in this connection this Department must be supported by the fruit-growing section of the community, for satisfaction cannot be given to every person in the State.

There is no certainty as to the number of broods there are of this pest during the year, but the most destructive is that attacking the main crop of oranges during the autumn. The insect will be found breeding all the year round, but it is not common during the summer, a fact either attributed to the absence of suitable fruits or the activity of egg-parasites.

Perhaps no fruit contributes more to the preponderance of the insect than the China guava, which, from casual observations, seems to breed the brood which does so much damage to oranges. I have appealed to several parties in infested areas to destroy their guava plants, but unsuccessfully. Some contend that the guavas which escape the moth pay for the oranges destroyed. This may be, as the guava gets no cultivation; but, for my part, I cannot see that they even pay to pick, and I am sure that an orange-grower could do very well without a fruit which has scarcely anything to recommend it except as conducive to an attack of colic.

The damage done by this *Carpocapsa* to summer fruits is actually nothing, and this provides a peculiar comparison with the work of the Fruit Fly. The moth is kept going throughout the summer in a modified way by the stone fruits and makes its chief onslaught on to a winter crop, whilst on the other hand the fly is maintained throughout the winter in many places by the oranges, guavas and loquats*, and does its greatest damage to the stone fruits.

In my third report (1902) it was indicated that certain experiments for the control of this pest would be conducted. It may be said at the outset that it was found that the larvae could not be obtained by bandaging the trees as with the true Codling Moth, but that they are always carried to the ground in the fruit which, directly it is affected, rapidly and prematurely ripens and falls. The experiment was therefore confined to spraying with Bordeaux mixture poisoned with Paris green.

The fungicide was used against lichens and fungi which needed control, and the Paris green was applied with exactly the same object that it is used in spraying in apples, *i.e.*, to poison the young worm on emerging from the egg and before eating its way into the fruit.

The spraying was done by Mr. W. McFie, jun., at his place in the Town Bush Valley, an area in which the moth abounds.

I was unable to give more than a cursory supervision to Mr. McFie's experiment, which he conducted upon a fairly large and practical scale, using somewhere about 1,200 gallons of mixture on his trees. The Bordeaux was the normal 6.6.50 mixture, with 1lb. Paris green to every 100 gallons.

Two applications (600 gallons each) were applied from an ordinary barrel pump, for which Mr. McFie improvised an excellent carriage. An exact amount of the whole cost was not kept, *i.e.*, the native labour and supervision, but the bill for materials amounted to—

Paris Green	£1	0	0	
Bluestone (about	2	10	0	(144lbs.)
Lime	0	12	0	

No data was kept, so I am unable to appraise the value of the

* Also late pears. see under Fruit Fly.

work, but I understand from Mr. McFie that it was quite satisfactory, and he expressed his intention of continuing the treatment.

I wish to again emphasize the necessity of gathering all fallen oranges and burying them. For this purpose a large pit should be dug about 4 x 4 and 8 feet deep. Into this the oranges are thrown as often as they can be collected, and at each week end 4 or 5 inches of soil must be thrown on top of them. The fermentation of the decaying oranges will destroy many larvae (which take about 30 days to develop into moths after the orange falls), and will further prevent the emergence of any moths which may come to maturity.

I have been questioned regarding the manurial value of the contents of these pits, and therefore append the following:—

THE FERTILIZING VALUE OF CITRUS CULLS.

(Bulletin 139, University of California.)

"It is clear that each fruit represents the ingredients which will be required to produce another in the future; and in accordance with the golden rule of returns to the soil, they should be given back. The question arises, however, as to the exact value represented, and the expense the grower can afford to go to save it, as against purchasing fertilizers in the market.

"The ash percentage of fresh citrus fruit is (in California) ·43 per cent. on the average. Analysis shows that of this amount about one-half is potash, while ·053 per cent. is phosphoric acid. Or, stated for 1,000 pounds of oranges, we have 2·11 pounds of potash, 1·25 pounds of phosphoric acid, and, besides, 1·83 pounds of nitrogen in the fresh fruit. Assigning to these ingredients their accepted commercial values, we find the manurial value of the 1,000 pounds, aside from the humus, to be about 30 cents (one and threepence); it will not exceed 40 cents (one and eightpence)."

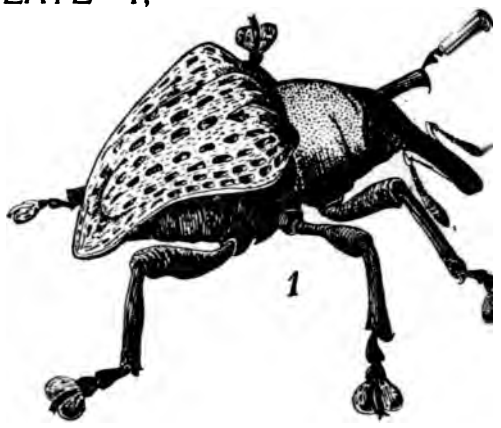
THE CODLING MOTH OF THE APPLE.

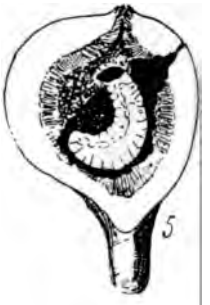
Carpocapsa pomonella.

Mention was made in my first report of the fact that this pest had, many years ago (Howard), been recorded as occurring in Natal. I stated further that it had not then come under my observation. At the time there was some doubt in my mind owing to a belief amongst some acquaintances that the pest did exist in an orchard in the Karkloof. The foundation for this belief rested on the appearance of certain pears which regularly suffered from insect attack. Upon investigation it appears that this damage is entirely due to the Fruit Fly (*Ceratitis conjsa*), although it must be admitted that in these pears the workings and tunnelings of the maggots much resemble the damage done by the caterpillar of the Codling Moth.

PLATE I.

3





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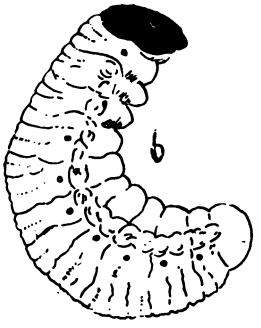
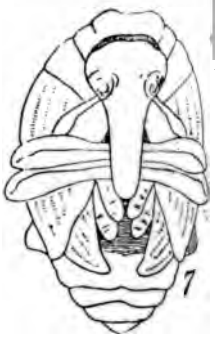




THE FIG CUCULIO (ALL ENLARGED).

EXPLANATION OF PLATE I.

1. Adult Female Fig Cuculio.
2. Diagram of cross section of an egg pit ; showing A, the primary pit, B, the secondary pit in which the egg is placed, D, the gummy plug.
3. Top view of an egg pit with gummy plug C removed to one side. A, the primary and B, the secondary pit.
4. The egg. The upper region is out of focus and does not show the honey-combed marking.
5. *Section* of fig showing grub at work.
6. *The grub.* 7. The pupa.

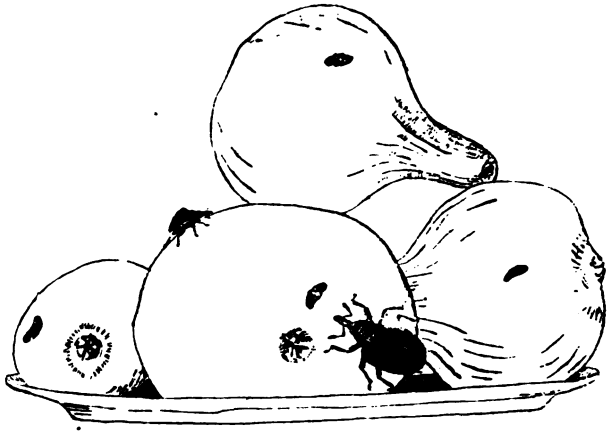
CUTWORMS.

Agrotis sp.

It is pleasant to record that, in accordance with circumstances, ıite a number of parties have reported to me upon the success of *th* poison baits and winter ploughing in mitigating this nuisance.

THE FIG CURCULIO.

Metatyges turritus, Pasc.



Group of figs, showing male and female curculio and egg pits.

(Plate I.)

The Fig Curculio is an interesting and destructive pest, coming ıder my observation for the first time in Natal early in 1904.

The term "Fig Curculio" has been applied because the creature very destructive to figs in the first place, and in the second place is a curculio much resembling the notorious "Plum Curculio" of e United States, not only in general appearance, but also in habits.

My attention was first drawn to the injury caused by it by the agistrate, Mr. Gibson, when at Greytown in January, 1904. Mr. ibson was then a new-comer to the district, and the pest had come nder his notice for the first time. A little later the beetle was re- ɔrted to me by Mr. Anderson, of Aberfeldie, Maritzburg. From [r. Anderson, who is a very old colonist, I learned that this was the rst experience he had had of the insect. It had never appeared be- ɔre on his place, nor had he ever heard of it.

The insect was kindly determined for me by Mr. L. Peringuey, ho, in sending the determination, says: "I had it from Umtali, where also attacks fig crops. It is found south as far as Port St. John's, ıd may possibly occur in the Kowie. It extends all along the East ɔast. I wonder if its native haunt is not *Ficus natalensis.*"

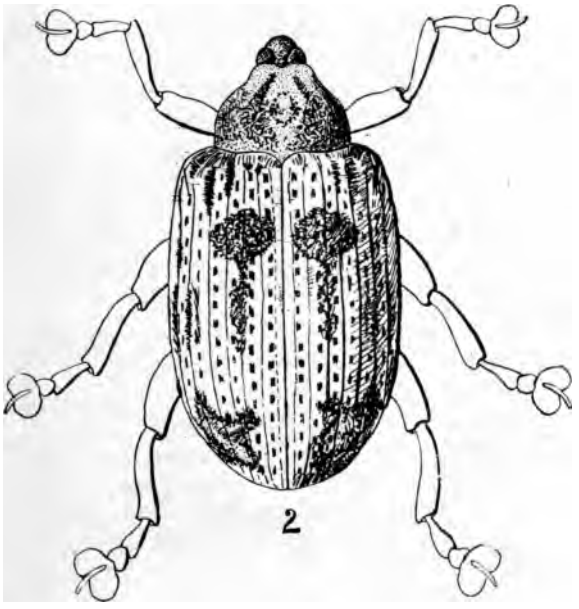
Specimens of infested figs, from which adults were reared, were received in Capetown by Mr. Lounsbury during February, 1899, from Kei Road and from Komgha.

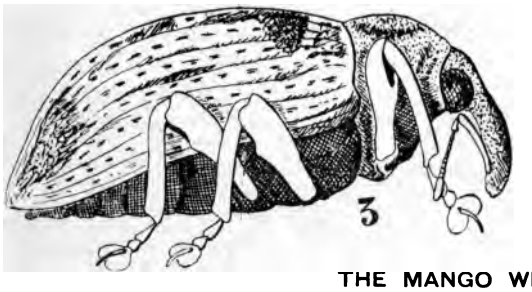
The adult female weevil is a thick-bodied beetle half an inch long and ¼ inch wide. (Figure I. Plate I.) When viewed from above, however, but little more than half its length is seen, because the thorax and long trunk-like head are bent downwards. In consequence of this the beetle has a humped appearance. The male is similar in appearance to the female, but only about one-third its size. On first emerging from the pupa stage the weevil is of a light, grey colour. This is due to the presence of a fine coating of powdery matter which rubs off very easily. In the absence of this coating the insect is almost black in colour. In point of fact, it is of a dark, bronzy colour. The back is rough in appearance, owing to several elevations and numerous pits arranged in parallel rows. The antennae, or feelers, project on either side of the snout, in front of and below the eyes. The legs are strong and of the same colour as the body, and when disturbed are drawn up close to the body, whilst the insect simulates death.

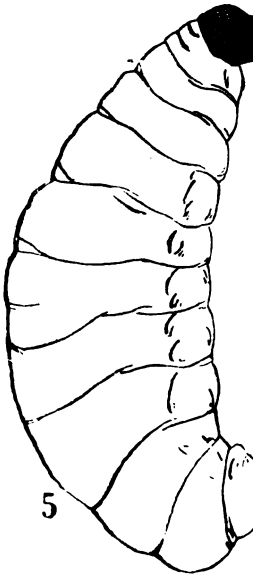
The female curculios, which had survived the winter, commenced laying their eggs in the earliest figs, whilst the fruit was still green, and about an inch in diameter. Later the very small figs of the second crop are attacked, the beetles both feeding upon them and laying their eggs therein, when they are no more than half-an-inch in diameter. The first eggs were found during the first week in October—about as early as the attack could reasonably be expected.

In ovipositing, the creature works in a manner very similar in general to the plum curculio of America. Though perhaps not so elaborate, the same purpose is secured. The insect first bites a deep incision into the fig with her snout. This is, as a rule, about one-tenth of an inch deep and equally wide. Occasionally, the incision is a circular pit, but, as a rule, it is twice as long as wide. In one side of this pit a secondary pit is cleverly made to half the depth of the first. It is a "cave in the wall" practically, and at the bottom of this the egg is found. (Figures 2 and 3, Plate I.) After depositing the egg it would appear that the insect gathers the gummy exudation or regurgetates the portion of the fig she has removed, and packs it over the egg, fills the secondary pit to the mouth, and jambs the remainder in the centre of the first incision, completely blocking up the entrance to the egg chamber. The egg is quite conspicuous, being of a fleshy pink and oval in outline. (See Figure 4, Plate I.) The surface is nicely sculptured with a honey-comb pattern. In its greatest diameter it measures 0·05, and in its smallest 0·04 inches. The larva (Figures 5, 6, Plate I.) then eats its way into the heart of the fig and there feeds to maturity. It is white, fleshy and maggot-like, having no feet and a horny head. When it hatches from the egg

PLATE II.







THE MANGO WEEVIL.

EXPLANATION OF PLATE II.

1. Mango Kernal showing damage done by grub.
2. Adult Weevil, top view.
3. ,, ,, side view.
4. Pupa.
5. *Grub.*

(Figures 2, 3, 4 enlarged.)

't works its way into the heart of the fig, and there feeds to naturity and pupates. (Figure 7, Plate I.) As a rule, the fig falls efore the transformation of the beetle is complete. The egg itches in about three days after it is laid. The grub grows rapidly, id reaches full size in 19 days. The time spent in the pupa stage about six days.

Mr. Anderson tells me that his figs were attacked all through the ason, pointing to a series of generations. I am, however, of the inion that the creature is two-brooded, and the beetles hybernate roughout the winter.

SUGGESTIONS.

The Fig Curculio is a pest which should be readily mitigated y the destruction of all infested figs. Figs which have been attacked re practically valueless, and should be picked and destroyed (unss one were prepared to go round and carefully pick off the eggs). Again, it is extremely easy to tell if a fig is attacked, because the puncture is so large and conspicuous. When it is seen that the figs re being attacked, a sharp look-out should be kept for the beetles, which should be hand-picked and destroyed. If the egg punctures re found and the beetles unobserved, a sheet should be placed under he tree, which should then be jarred by hitting with a muffled stick. This will bring the insects down on to the sheet, whence they may be emoved.

THE MANGO WEEVIL.

Cryptorhynchus mangifera, Fabricius.

(Plate II.)

During the past few seasons my attention has several times been rawn to this insect enemy of the mango. Unfortunately, I have ever had any opportunity of personally inspecting affected fruits, nd so can give but little account of the pest and the extent of the lamage done to the mango crop.

Writing to me under date of 26th January, 1903, Mr. Arthur . Allkins, of Verulam, says:

"I do not know if your attention has been directed to a caterillar or grub which destroys the seed of mangoes. I believe that 60 o 80 per cent. of the seeds are destroyed by them. Even the seed f apparently sound fruit will be found infested with them.

"I am sending you specimens of affected seed, larvae, pupae nd mature insects."

In forwarding further specimens a few days later, Mr. Allkins emarks: "The mango seems to be in no way damaged by the attack f the weevil except in the stone. I cannot find the slightest mark n the shell of the stone, even with the aid of a magnifying glass, to

show where the entrance was made. As the stone is useless for planting, the weevil is not altogether harmless."

The mango weevil is a native of India, and has, doubtless, been introduced in seed from that country to Natal, just as it would appear to have been introduced into the Islands of Mauritius and Madagascar, where it is known to exist.*

In 1889 the pest was reported as spreading out over India in a westward and northward direction from Dacca and the direction of Burmah, to which it was at one time apparently restricted.

The ovipositing, or laying of the egg, is obscure. The natural inference is that the egg is laid beneath the rind of the fruit, as in other cases of weevil attack upon fruits, and that the young grub, or larva, bores its way into the kernel, the passage being occluded by the growth of the pulp. Such, however, is not the case, and where larvae are found in the kernels of immature mangoes there is absolutely no indication to support such an idea. The rind and the pulp and that portion which ultimately forms the hard shell show no trace of the insect's presence within, however carefully sectioned and examined. In fact it would appear as if the egg were deposited in the skin which envelopes the kernel. In this skin the workings, like pencil lines, of the young maggot are first noticed, feeding at the beginning below the outer membrane and later in the body of the cuticle, without touching other parts. When a little larger the grub seems to eat portions of the skin, driving its tunnel through the skin without affecting any other part. Later it commences to feed upon the kernel, eating a chamber in it and driving therefrom five or six radiating tunnels, as shown in Figure 1, Plate II. The first attack, as a rule, begins at the apical end of one side of the kernel, and afterwards the grub seeks the other side to form its chamber, in which it subsequently pupates.

I imagine that the egg is deposited upon the ovule in the mango flower before pollenization, and does not hatch until the fruit is a little larger than the pigeon's egg. The peculiar structure of the female flower of the mango lends itself in support of such a supposition.

Mangoes set their fruit about October, and it is therefore extremely probable that the beetle spends two to three months as a grub feeding in the kernel. The pupa stage is apparently short, and is also spent in the kernel from which the adult beetle emerges.

There would appear to be only one brood of weevils in a season, the adults living over from January and February until next spring. In fact, out of some half-dozen weevils sent me by Allkins on January 30th, one was alive on the 26th of May. beetles were confined in a small cardboard box without any whatever, and the majority lived for three months.

* Indian Museum Notes p. 45, Vol I. Part I.

DESCRIPTION.

The mango weevil (see Plate II., Figures 2 and 3) is a small nconspicuous beetle measuring about 1-3rd inch in length and about alf as wide as it is long. It is of the typical weevil shape and appearance; that is, the back of the body is very convex and the head prolonged into a stout trunk or proboscis, bearing a pair of antennae on each side and the biting mouth at the apex. As is often the case in many weevils, this head is bent downwards and hardly observable when viewing the insect from above. The general colour is brown, with inconspicuous markings of a lighter hue. The shell of the beetle is extremely hard. When disturbed the insects immediately tuck in their legs and feign death like a tortoise.

The pupa, as found in the mango, is white and the parts of the adult beetle plainly discernable. (Plate II., Figure 4.) The grub is white, stout and without feet, resembling in some respects a large fly-maggot. (Plate II., Figure 5.)

THE NATAL MAGGOT FLY.

Myasis.

Bengalia depressa.

(Plate III., Figure 3.)

This pest has not been so prevalent since its abundance in 1901. It was my hope that I should be able to make some proper study of it, but there has been no opportunity of doing this.

The material now in my possession is very small and consists of but three authentic specimens. These consist of one male and two females. The male was reared from a maggot given to me by Mr. S. F. Quekett, and taken from a European; one female from a maggot expressed from the scalp of an Indian servant at Mount Edgecombe, and the other from a "sebunga" maggot. With regard to the "sebunga" maggot, it may be stated that these are commonly found in the cracks and crevices in the neglected flooring of old kafir huts; particularly those inhabited by old women, who are too old or too indifferent to keep the floor in good order or the hut clean. I think Mr. H. Millar, of Durban, first told me of this insect when I had related to him my experience with the young larvae of the "Maggot Fly," as detailed later. He then told me that they were to be found in the floors of old huts, and that at night they came out and, like a bug or a flea, fed upon the blood of the sleeping inmate. Later, on mentioning the matter to Colonel Friend Addison, he confirmed what Mr. Millar had told me, saying the creatures were well known to the natives, and he promised forthwith to get me specimens. Shortly afterwards two maggots were sent to me from near Stanger, and one was successfully brought to maturity. The adult fly, which is a

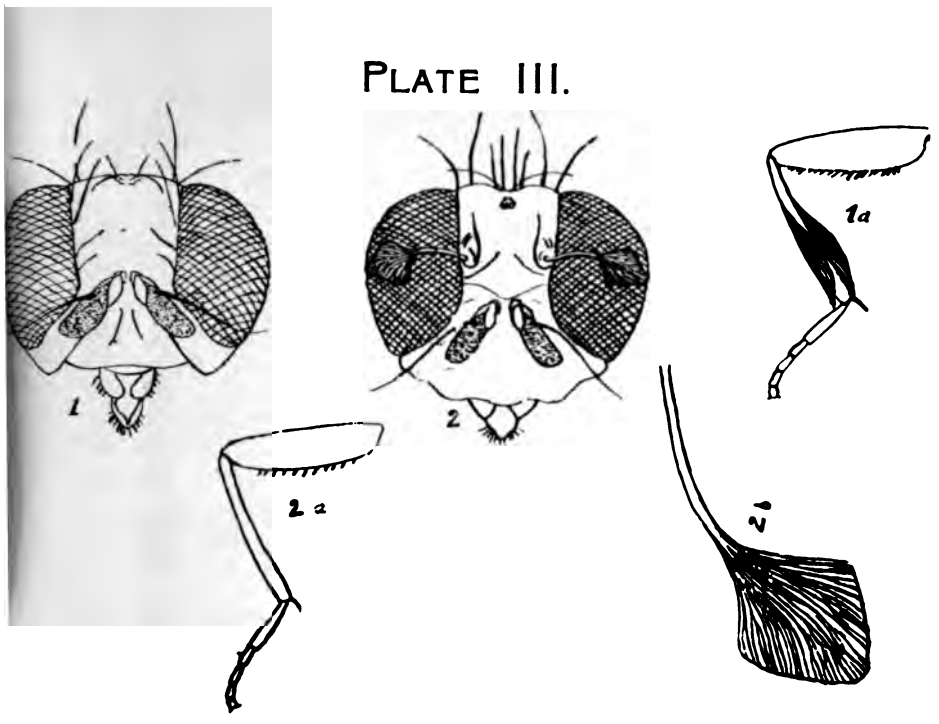
female, is, so far as I can make out, identical with that reared from the Indian's scalp. In my mind there is no doubt that these larvæ of the Maggot Fly (*Bengalia depressa*) live indifferently in tumours in the flesh or as described above.

In 1901, when there were numerous cases amongst Europeans of all ages, and dogs and rabbits on the coast, and particularly in Durban, there were several communications to the Press from people who had had some experience of it, and about that time I met numbers who had been infested. Except in one instance, none of the sufferers knew how they became infested, nor knew they were until the maggot was expressed from the boil-like tumour. In the instance cited, the correspondent wrote to the effect that the eggs were laid in the beds, particularly of children, and there hatched. The young maggots attacked and bored their way into the victim whilst sleeping. The correspondent added that he or she had repeatedly captured these maggots when making their way into the skin. Of this extraordinary manner of attack I have no confirmation, but it is difficult to otherwise account for the entrance of the parasite. There can be no question of cleanliness for I have friends, whose morning tub is as regular as the days come round, who have been infested. On the other hand there are cases of gross infestation, particularly of babies' scalps, which were doubtless due to the presence of the thick layer of scurf common to some young children. No portion of the body has not been attacked, according to reliable evidence which has been tendered to me, scalp, neck, face, nose, back, buttocks, breast, abdomen, scrotum, thighs, calves of legs, arms and fingers.

In November, 1901, Mr. Robbins, stock inspector, sent me a living adult female which he had captured in his room at Bond's Drift. He forwarded it with the comment that he was sending me alive a Maggot Fly. This had deposited eggs before arrival, which hatched in the course of fourteen days. With a view to testing their biting and penetrating power, I at once applied some of them to the skin of my arm. They almost at once attacked the epidermis, rasping it away until the blood flowed. There was practically no sensation from the bite, although my attention was concentrated on the operation. The maggots did not burrow, however, and as soon as they were engorged fell off, and buried themselves when placed in some sand. This process was repeated on several later occasions, but, unfortunately, I was suddenly called away from headquarters, and when I returned the creatures were dead.

The fly in question deposited 42 eggs. These were somewhat cylindrical, but thicker at one end than the other; the ends were rounded; colour, white; surface, faintly striated; length, 1-20th inch. The young maggots were 6-100ths inch long and quite white. After feeding, they were reddish owing to the colour of the blood. Maggots removed from pustules are invariably quite white, unless nearly mature, when they are of a dirty white appearance.

PLATE III.



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EXPLANATION OF PLATE III.

1. Front view of head of Natal Fruit Fly.
2. „ „ „ Mediterranean Fruit Fly.
1a. Intermediate leg of Natal Fruit Fly.
2a. „ „ Mediterranean Fruit Fly.
2b. Horn of Mediterranean Fruit Fly.
3. *The Natal Maggot* Fly.

The pupa is of the ordinary dipterous form and coated with a white meal. It measures 35-100ths inch in length and 15-100ths inch in the widest diameter.

The pupa period in two instances was about twenty days, the time taken by a maggot to come to maturity.

The period spent by the maggot in the body cannot be definitely stated. When noticed and expressed they are from one-half to three-quarters full grown. A friend in Maritzburg (where the pest is unknown) took his family to the sea coast for a month. A few days after returning a half-grown maggot was expressed from one of the children, so that the period cannot be more than 4—6 weeks. A correspondent was affected between the fingers. He first noticed a boring pain, which increased throughout a week, when a pustule formed. This was squeezed, and a full grown maggot expressed, which, being kept, almost at once pupated; it was put with cotton wool in a bottle, but died as a pupa."

Other cases were alluded to on page 657, vol. iv., *Agricultural Journal*, Natal. Several informants think the creature only lives eight or ten days in the skin.

THE MEDITERRANEAN FRUIT FLY.

Ceratitis capitata.

(Plate III., Figures 1 and 2.)

Amongst the batch of newly-observed insect pests which I have to record in this report is that known as the Mediterranean Fruit Fly, *Ceratitis capitata.*

This species, whilst no more aggressive than our local species, *Ceratitis corysa*, and attacking practically the same fruits, is still the most widespread of its kind. It assumed its most aggressive form first in the Mediterranean region (Spain), and hence its name. Subsequently it was introduced into the Bermudas, the Azores and Canary Islands. It became established in Cape Colony, and quite recently in Western Australia. It is the insect for a natural enemy of which the West Australian authorities sent George Compere searching about the world.

I well remember, when in Western Australia, this question of a natural enemy being discussed amongst the staff, and, whilst we realised that there was some hope of obtaining some parasite which might control it, I do not think there was much display of optimism. Indeed, the paramount question was: Where to search for such a parasite. It was anticipated that such would be found in the native home of the insect, but that was an unknown quantity, nor could anyone hazard a guess as to where that land might be. The East Indies were thought of first, if my memory serves me correctly, and in that direction, I believe, Compere set forth, when, after several years of

contemplation, the Government decided upon the course. Some account of his journeyings have appeared in the *Agricultural Journal* of Western Australia, from which the following is gathered:—

A start was made from Western Australia on the 2nd October, 1902, and the mission extended to China, Japan, America and the Mediterranean regions. The first observations were made in China. Here little definite information was gleaned, though it is of interest to us in Natal to learn that both the Persimmon and Litchi are reported by residents as subject to maggot infestation. Japan was then visited, but nothing done. Thence Mr. Compere went to America. Here a fresh locality for the fruit fly, *Ceratitis capitata*, was learned of. This was Sao Paulo, Brazil. The identification was made from an insect reared from an orange. From America Compere travelled to Spain, visiting many districts of that country and finding that, owing to the ravages of fruit fly (the species whose recent appearance I am recording in Natal) the culture of the peach, nectarine and apricot had been abandoned. *Via* France, the traveller went to Italy, and appears to have found the fruit fly abundant there. Mr. Compere then returned to Australia; he had examined several places where the fruit fly abounded, but had come across no natural enemy.

About a year after his first start, on September 14th, 1903, a journey was undertaken to India. But there he failed to find the particular fruit fly, although numerous (20 in all) other destructive species were met with which attacked a great variety of fruits. None, however, were identical with that for the natural enemy of which he was searching. In India he found parasites of some of the native fruit flies, and he noticed that each particular fly had its peculiar enemies. This emphasised the necessity of carrying his exploration further until some place was found where the species we are now interested in existed and was parasitized. Attention was then paid to Brazil, where Mr. Compere had learned when in Washington the fruit fly (*Ceratitis capitata*) did exist. He had placed himself in correspondence with a gentleman there, and found that, whilst the fly existed there, it was looked upon as rare. Accordingly on 7th January, 1904, he again left Western Australia for South America. To conclude here, in Brazil two natural enemies of the fruit fly were found, and these have been introduced into Western Australia, where they are expected to control or mitigate to a great extent the ravages of the pest.

In South Africa there is no more formidable enemy of the fruit-grower than this pest, and the question arises whether or no we should take steps to secure a supply of these natural enemies. There is much to be said in favour of such a course, and the only thing to be said against the proposition is that the introduction of these "Insect Friends" may not come up to expectations. However, the

whole cost of such an experiment (probably £2,000) will be so small that I am of opinion that some steps should be taken. I know of one fruit-grower who calculated his loss from Fruit Fly attack in 1904 at £400. He is not a large grower, and, on this basis, the loss in Natal alone from Fruit Fly attack must annually come to more than £2,000, and this is a pest which is increasing and becoming more widespread every year.

These facts I consider it my duty to draw attention to, and it remains with those most interested in fruit-growing to take such action as they think proper.

At least one mystery has been cleared up by Mr. Compere's investigations; that is, the natural habitat of *Ceratitis capitata*, which so long remained in doubt. There can be no doubt now as to how the pest became distributed to many parts of the world.

The insect first became known to science by its description seventy-eight years ago. Seventy-five years ago it was reported from the Island of Madeira, and it is known to exist in several of the Mid-Atlantic islands. It is therefore extremely probable that it was first carried in fruit from the Brazils to these islands. As it has occurred in Spain for a very long period, it may also have been carried direct to there or came there from the Canary Islands. It has been known in the Bermuda Islands for nearly forty years, and it was the opinion in Bermuda that the insect was originally introduced during the American Civil War in cargoes of fruit brought from the Mediterranean. From Spain it has spread along the seaboard of the Mediterranean with an interchange of fruits. It occurs in Algeria and Italy, and appeared in Malta in 1875. There can be no doubt that it was transported to the Cape Colony from the Canary Islands, and to Western Australia by ship through the Suez from the Mediterranean.

There are specific differences between *Ceratitis capitata*, whose occurrence in Natal is now reported, and *Ceratitis corysa*, which has for so long been destructive in the Colony, though at a casual glance they do not amount to much. The chief distinguishing feature is the pair of knobbed appendages carried upon the head of the male *Capitata*; these are quite missing in *corysa*. But in the latter the tibiae of the middle legs are furnished on either side with combs of stout black hairs. Figures 1 and 2, Plate III., sufficiently illustrate the most prominent differences between the two species.

MOSQUITOES.

These insects have received a considerable amount of attention during last summer, and a fairly representative collection of local forms has been got together. Studies in the life-cycles of several have been started upon, and will be continued throughout the coming season. It is, however, too early to report in any detail on this sub-

ject. Amongst other matters, a further effort will be made to locate as far as possible, the chief sources of supply from which these pests are drawn about our several towns. In this connection it may be at once said that in the majority of cases where mosquitoes are troublesome it has been found that they invariably come from standing water in the immediate neighbourhood. This holds good pretty well throughout the Colony, though there are certain exceptions, such as Durban, but even there I am of the opinion that the mosquito pest could be greatly mitigated after a more thorough survey of their breeding grounds has been made. Upon the higher veld, whenever the pest has been troublesome about a farm, I have never experienced much difficulty in tracing the breeding ground. In a large number of instances this has proved to be some water tank or some stagnant pool, about the treatment of which no particular difficulty presented itself.

Altogether, some 15 to 20 species have been obtained, amongst which, up to the present, the following have been recognised:—

Anopheles cinereus (? a variety), Maritzburg.
„ *paludis*, var. *similis*, „
Culex fatigans, „
univittatus.
malicrura (?).
Toxorhynchitus brevipalpis.
Stegomyia (*nigeria* or *africana*).
Psorophora, *n. sp.*
Megarhinos. *n. sp.*
Taeniorhynchus, *sp.*

THE BAGRADA BUG.

Bagrada hilaris.

The Bagrada Bug (*Bagrada hilaris*).

This is a further new pest to record. That is not to say that has been newly introduced, by any means, but that it is only during e last 18 months that this South African insect has come under servation in Natal. It was sent into the office first by Messrs. osking Bros., Byrnetown, on 16th November, 1903, who then wrote at it was apparently doing serious mischief to cabbages. Later I served it near Maritzburg in small numbers, and since then it has en sent me from the Pongola, in Zululand, where it has also proved ischievous to *Cruciferae*. This insect was, I believe, first drawn tention to by Mr. Lounsbury in the *Cape Agricultural Journal* (21st ıly, 1898), and, as but little is known concerning it in Natal, I can- ɔt do better than quote from his remarks upon it. He writes: Complaints of the ravages of this insect have been numerous for the ıst year (1897-8), and have come from sections widely separated— :om Capetown to Kaffraria on the east and Uppington on the north. t has appeared so suddenly and over so wide an area that it is pro- ably an insect which, while always about, rarely becomes so in- ıriously abundant as to take rank as a pest. That it will disappear rom common notice as abruptly as it appeared is reasonable to sup- ɔse; and, as a grain of comfort to those whose crops are now afflicted, ve predict that its present era of destruction will terminate ere ıany seasons pass* . . . Nearly all of the complaints of the ısect have been of its injuries to cabbage, turnip and other members f the family to which these plants belong (the *Cruciferae*), but we ave found it injuring mealies (maize) in a small garden near Cape-

* As a matter of fact I believe this was the case.—C.F.

town,* and have been told by one or two correspondents that cereals suffer to some extent . . . . in contending with a pest of the nature of this one; it is quite necessary to know something of its round of life. . . . It has already been stated that the insect under discussion is a *bug*.

"One of the principal characteristics of a bug is the possession of mouth parts adapted only for piercing and sucking. There are no organs at all for biting and chewing, the food all being taken in liquid form through the suctorial organ, the 'beak.' There is therefore no chance of destroying a bug by coating its food plant with an insoluble poison such as Paris Green, Climax powder or Hellebore, poisons which act so efficaciously on chewing insects like the Codlin Moth larva and Pear Slug. Unless such poisons as these entered the juices of the plants, they would not seriously affect the bug's welfare; and, if they did enter the juices, the plant would be poisoned before the insect.

"Another peculiarity of bugs is that there are no striking changes of form with intervening periods of rest such as we are familiar with in many other insects. Maggots ultimately become flies, caterpillars become moths or butterflies, and grubs become beetles; but when it emerges from its egg shell, a bug, like a locust, differs only in detail with its parent. The principal difference is the absence of wings; but, as with locusts again, these organs are developed with successive changes of the skin without a period of dormancy. In dealing with the Bagrada bug, then, we know that there is no inactive stage when it is particularly vulnerable as occurs with some of our other common pests; and know that an insecticide to affect it must be one that kills from without—that is, an external or contact insecticide.

"Then comes the question of what contact insecticide is applicable in this case, and whether or not its application would prove economical. Paraffin emulsion, pyrethrum, soap washes, lime and sulphur, resin wash and sheep dips are all insecticides of the desired class; but experience with these substances on plant feeders of the Bagrada bug type teaches us that only the first possesses any great degree of efficacy. When we come to consider the expense of paraffin emulsion, however, and the trouble of preparing it and applying it to crops such as are attacked by this insect, we are justified in concluding that the remedy is not an appropriate one, except, perhaps, in small home gardens.

"The use of a spray is then thrown out of consideration. We may turn to a more direct method of destroying them. During the cool parts of the day, these bugs, like many other insects, are sluggish, and may easily be dislodged from the food plants. This renders it practicable to greatly reduce their numbers by jarring the infested

* Mealies are such poor things near Capetown that almost any creature is strong enough to injure them.—C.F.

plants over a dish or pan containing some substance that will hold or destroy them; paraffin is a good substance for this purpose. This jarring method is entirely applicable to some kind of plants: Stocks, for instance, and even for vegetables in a small garden, but, obviously, would hardly prove a paying one in a great field of turnips broadcasted for cattle.

"Remedial, or direct measures, proving unavailable, less direct or preventive measures are to be considered. And the preventive measure which long experience has taught farmers in dealing with just such pests as this one is clean culture. By this is meant not only restricting the plant growth on the land to the crop alone, but also and more especially the thorough cleaning up of the land after the crop is harvested. In direct opposition to clean culture is the common practice of allowing worthless cabbage sprouts and odd turnips to continue to occupy the land. When clean culture is practised, the land is practically cleared of the pest at the end of the season, and no nourishment or shelter is left for the off season. Examine cruciferous plants now standing on land in which grew a crop much infested with this pest last season, and you will be almost certain to find plenty of the creatures; it takes little food to sustain them now in this, the winter season, and a plant here and here on the land will carry enough over to thoroughly infest a crop next summer. Incidentally, in examining the plants you will discover the will-be propagators of the coming season's crop of Cabbage aphis and Diamond Back Moth—the former the bluish plant louse, which not infrequently kills the plants when from any cause whatever these lack vigour, and the other the insect which lays the eggs for the tiny green caterpillars which eat the face of the leaves; this latter insect, like the Bagrada bug, will be found in all stages of development.

"We know a market gardener near here whose cabbages were nearly all destroyed by the Bagrada bug. Having occasion to visit the place a few weeks ago, we noticed a bed of stocks growing just across the path from where the cabbage bed is situated. Many of the stock plants were dead, and the remainder appeared in an unthrifty condition. The cause of their low condition was not difficult to determine, for the plants were simply thronged with bugs; these, while evidently finding the stocks to their present liking, were doubtless waiting for the joyous spring and another crop of cabbage seedlings. A mixed garden in an Eastern Province town gave us an opportunity of making a similar observation nearly a year ago; the cabbages and turnips had proved a failure owing to the ravages of the bug, and no plants of this kind were then in the garden, but the neglected bed of stocks was there, and each plant harboured hundreds of the bugs. Does not a similar condition of affairs exist in the gardens and lands of our readers, worthless cabbage stumps, perhaps, replacing the stocks?

"To sum up, our knowledge of this pest assures us that a proper observance of the following 'do nots' and 'dos' will do much towards minimising its injuries to crops.

(1) Do not plant crops of cruciferous plants which grow at different seasons of the year near one another. If you do the bugs, after finishing with the first, will migrate to the other.

(2) Do not allow weeds, least of all cruciferous weeds, as mustard, nor remains of a former crop, to remain on the lands after ingathering.

(3) If a crob becomes worthless through the attacks of the bug, have the plants removed at once, so as to destroy the infesting bugs.

(4) Practise rotation of crops when possible.

Where practicable, as in small gardens, destroy the bugs by jarring them from the plants into pans containing paraffin."

GLOVER'S SCALE.

Lepidosaphes (Mytilaspis) Gloverii, Packard.

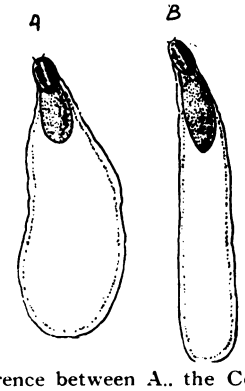

Diagram showing the difference between A.. the Common Mussel Scale, and B., Glover's Scale.

When in Natal during last November, the Transvaal Entomologist informed me that he had seen this peculiar scale insect upon some Natal oranges, or, at least, some oranges said to have come from Natal. I cannot say that I readily accepted the statement, as, though I have examined many citrus orchards during the past four years, this pest had never come under my notice. Unfortunately, at the Agricultural Show held at Stanger this year, in judging the citrus fruit, I came across one lot of oranges slightly infested with Glover's Scale, so that the pest does at least occur in one orchard in Natal.

This scale insect is supposed to have come originally from China, and to have been introduced directly from there into Florida between 60 and 70 years ago. Comstock, writing of it in 1880, says: "This *is a very common* species on citrus trees in Florida and Louisiana. It

ects the fruit, leaves and bark of the trees, and is usually associated th *Mytilaspis citricola*" (the commo nmusel scale of citrus trees Natal).

Glover's scale is very much like our common mussel scale, except at it is usually much lighter in colour and also narrower. It is ɔt possible at present to say whether it will prove a more harmful ecies than its well-established ally; but an effort must, in any case, ɜ made to stamp it out before it becomes firmly established. The lustrations above illustrate Glover's scale and the common mussel ale, and show sufficiently the characteristic difference in shape.

PERGANDE'S SCALE.

Parlatoria pergandii, Comstock.

This scale insect, which was named by Comstock after Mr. 'ergande, has recently been observed in a Durban nursery. It is matter of conjecture how it has gained a foothold, but its presence dicates another addition to our citrus pests. As with Glover's ale, this was found infesting the trunk leaves and fruit of citrus ees in Florida by Comstock. Speaking of it, he says: "It occurs ore abundantly on the bark of the small limbs than on any other rt of the tree; occasionally, however, it very thickly infests the uit." In the nursery where I noticed it the scale was as yet unmmon and found only on the fruit and leaves of some trees growg within two or three feet of the nursery rows of citrus trees. This ale has also been observed at the Port on oranges from the Mediɪranean, and quite recently a very large consignment of oranges as fumigated because it was infested with it.

Pergande's scale is round in shape like the red and purple scales f the orange. But it is much flatter and thinner and not as conɪicuous as either of the above. The colour of the scale is generly a dirty grey, though sometimes pink. This scale should yield adily to either spraying or fumigation owing to the thinness of the hield with which it covers itself. It is, moreover, an insect pest toards the extermination of which every effort should be made before has become well established in the Colony.

THE WHITE PEACH SCALE.

Aulacaspis crawii, Ckll.

This scale still retains a mild status as a peach insect. In the cinity and precincts of Maritzburg one, however, meets many cases badly-infested trees, particularly neglected seedlings. There is, erefore, ample evidence that the pest is serious enough, but has t had much opportunity of becoming generally distributed. In is connection too I regret to say that instances of its occurrence in

orchards are not so rare as formerly, although no complaint has yet been made of it.

The so-called "Syringa," or white cedar, *Melia adzerach,* is much infested with a form of this scale, which has been described by Professor Cockerell as a variety (*Aulacaspis crawii, var. fulleri*). In the majority of cases these trees are neither useful nor ornamental, and it would be a wise proceeding to destroy all that are infested.

I regret to add that this scale has a very pernicious effect upon the Passion Fruit (Granadilla), which is liable to become badly infested and destroyed by it. As a rule, these fruits are never trained, but trail over some fence or out-house, and when infested are most difficult to treat. I find that the scale insect invariably attacks the main stem first and from there spreads over the vine. It is therefore suggested that passion vines should first be trained to a single main stem for several feet. If this is done the scale can then be very easily removed, it being possible to completely keep it in check by occasionally rubbing it off with a cloth. If, of course, the cloth is dampened with paraffin emulsion the operation is all the more effective.

ROSS' SCALE.

Chrysomphalus (*Aspidiotus*) *Rossi,* Maskell.

The appearance of this scale-insect in Durban draws attention to the spread of insects over long distances. Ross's scale is a common Australian insect which does practically no damage in its native territory. In Durban it was found by a correspondent upon a *Eucalyptus,* but that is the only instance which has been met with. The pest is, however, fairly common on *Acacia melanoxylon* in the streets of Pretoria, and there are possibilities (though small) of its becoming a nuisance here.

In Australia it has been met with upon a number of plants, native and exotic, but is not regarded as a particularly destructive insect.

This scale very much resembles the circular black scale* often met with on citrus trees on the coast. It is, however, quite distinct from this. The scale is not such a regular circle and is blacker, the purple tint being absent, and, further, the characteristic central red boss of the citrus scale is absent.

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* For a description see page 100, 1st Report.

LOCUSTS.

This report covers a period embracing two Locust Campaigns. regards the 1902-3 season, the Chief Locust Officer's report has eady been printed, and his report for the season 1903-4 is apnded. It is only necessary for me to draw attention to the very avy work of last season, owing to the magnitude of the invasion. any more swarms came into the country than at any time since I ok up duties in 1899, and eggs were deposited throughout Zululand id in the three lower zones of Natal. As a matter of interest, I aw attention here to the locust zones into which the Colony is aprently divided. Owing to want of information, it is impossible to y how far and in what direction those zones enter into Zululand, ut they have been pretty well defined in Natal. They are:

The first, or Littoral Zone.
The second, or Midland Zone.
The third, or Thorn Country Zone.
The fourth, or Highland Zone.

Diagram A. roughly indicates the contour lines of elevation of ie Colony, and Diagram B. the Locust Zones, and show how closely e insects have been governed by the lines of elevation in selecting eir breeding grounds. In view of the fact that during the great vasion of ten years ago locusts laid eggs all over the Colony, even Highlands (5,000ft.), it must be realized that the whole Colony suited to them, and that mere elevation has no direct bearing on e point when all conditions are equal. Every spring we find swarms locusts crossing our northern boundary at every point and migrat- g across the midlands southerly and coast-wise. We find that they variably deposit eggs earliest on the coast, and later up-country.

One is therefore to assume that climate has a most important aring upon their egg-laying, and where spring is earliest there the arms foregather. In other words, when the spring is late up- ountry, the locusts are more confined to the coast belt.

The first, or Littoral Zone, of which I have spoken contains the unties of Victoria, Durban, Alexandra and Alfred. The second, Midland Zone, comprises the lower and eastern portions (under 000 feet) of Umvoti and Pietermaritzburg Counties. The third, Thorn Country Zone, includes those portions of Umvoti, Weenen d Klip River Counties lying about the valleys of the Buffalo and gela Rivers. With regard to the laying of eggs, we find that in e season—

1899-1900 eggs were laid only in the littoral zone.
1900-1901 ditto. ditto.
1901-1902 eggs were laid in 1st zone chiefly, a little in 2nd, and one lot in 4th.
1902-1903 eggs were laid in 1st and 2nd zones.
1903-1904 eggs were laid in the 1st, 2nd and 3rd zones.

Concerning these "locust seasons," it may be said that the first three were mild. During 1901-2 a batch of eggs was laid in the fourth zone, near Gourton, but the locusts which deposited these came across the Drakensberg and were an erratic swarm. The second zone was really not badly infested, and most of the young locusts were born near the coast. In 1902-03 only the littoral and second zones were selected as breeding grounds, and the invasion was larger than formerly. The last season, 1903-4, was an exceptionally bad one, and the work of destruction extended from the coast to Dundee, 120 miles inland.

It is perhaps well to mention here that there is little doubt in my mind that nearly all the swarms which deposit eggs come from the north of the Colony, and comparatively few of their progeny escape destruction in Natal. One cannot help surmising further that, apart from the great hordes annually destroyed each summer, there is a great decadence amongst those coming to maturity. Indeed, if it were not for these itinerant locusts which arrive from August to December, the Colony would be speedily free from the pest. This is a fact which, unfortunately, few of our farmers realise. They clamour for the Government to destroy the locusts and immediately see the good results, but when the next spring arrives and with it more invaders, complaints are rife that the previous season's work was not thoroughly done.

It may be said that of late the trend of visiting swarms has been across the uplands from N.W. to S.E. The first swarms appearing make their way gradually coast-wise, doing but little damage, and arriving there deposit eggs, augmenting the supply coming down the coast from Zululand and such as have been in winter quarters on the coast. The laying of eggs in the second and third zones is due to the later arrivals.

In my previous reports I have neglected to mention, as a matter of interest, that the locusts do not attack the Tea plant or the Mandarin Orange.

PLATE IV.

RHUBARB BLIGHT.

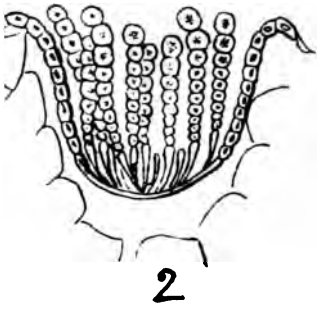
EXPLANATION OF PLATE IV.

Undersurface of diseased Rhubarb leaf.
Upper surface of ,, ,, ,,

PLATE V.

1.

5.



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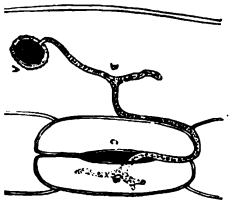

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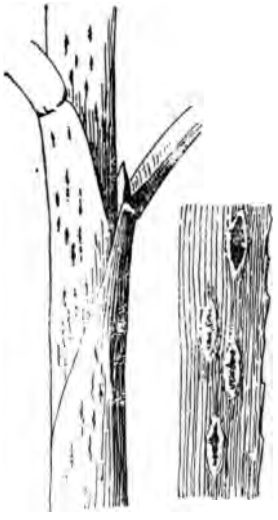

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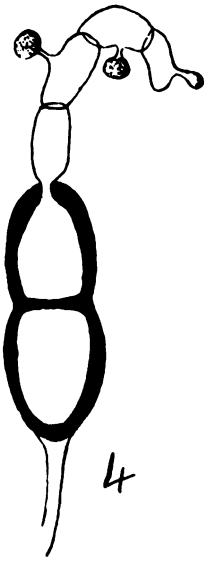


4

RHUBARB BLIGHT.

EXPLANATION OF PLATE V.

1. View of diseased spots showing cluster cups.
2. Diagramatic section of a cluster cup.
3. Red rust stage on stem and leaf.
4. Telento spore germinating.
5. Red rust spore.
5. *Red rust spore* germinating.

THE RHUBARB BLIGHT.

Aecidium rubellum.

(Plates IV. and V.)

In my last report some reference was made to this peculiar ɔease of the Rhubarb, though no account was then given of it.

My attention was first drawn to it by Mr. Cotton Acutt, of ɔsetta, who forwarded affected leaves during October, 1902. The ight appears upon the upper surfaces of the leaves in the form of rcular blotches of a bright crimson colour, and varying in size; ough, when not confluent, generally ¼ of an inch in diameter. pon the under surfaces of the leaves these spots appear of a light ɔsh colour and somewhat cushion-like, being depressed in the centre. igures 1 and 2, Plate IV., illustrate the appearance of both the ɔper and under-surfaces of the diseased leaves; they show the dis- ɪse in its most aggravated form, and it varies from this degree to ɪat of one or two spots upon a leaf. Upon the whole, the disease ɪnnot be regarded as a very serious one for, as is shown later, it is ɪsily controlled, and further, in its worst form, it has not been ɔticed to destroy the plant, and but slightly decreases the yield. rom the point of view of one interested in the study of such blights, may be described as a beautiful parasite. The vivid, crimson ɔlour which suffuses the blotches when viewed from above is only ɹualled by the soft, velvety flesh colour of the cushion on the lower ɪrface. Figure 1, Plate V. Under the microscope this cushion ows up as a field of fantastic beauty, as it is composed of numerous ɪtle flower-shaped cups containing innumerable microscopic gran- es, which are the seeds or spores of the parasite. These small ps, which are popularly spoken of as "Cluster Cups," are set closely gether, and appear as minute orifices in the leaf's surface set ound with a toothed fringe. (See Plate V., Figures 1 and 2.)

This disease has also been noticed, adjacent to the Rhubarb ld, upon the common Dock (*Rumex sp.*), a plant which is closely lied to the succulent Rhubarb; but up to the present it has not en seen upon any other plant. The life-cycle of the parasite is ost interesting and somewhat difficult of comprehension to those ɪo have not studied this branch of natural history. In my first port I dealt somewhat at length with what we commonly refer to "Forage Blight" in Natal, and I explained that this disease was ɪe to one of the "rust-fungi." It was further pointed out that, ɪder certain conditions of climate, Forage Blight went through veral distinct stages, in one of which it attacked another group of ants, and appeared in an entirely different aspect. Now that fferent aspect is almost identical with this Rhubarb Blight. In lating the study of the rust-fungus of forage, it was shown that e disease first appeared as rusty-red spots which produced millions

of red grains or spores. These spores alight on the leaves and stems of the oat-plant, take root there and grow, forming fresh diseased spots. It is this rapid growth of the red spores which intensifies the disease and makes it so pernicious during the summer. It was pointed out, however, that later on another form of spore was produced. A black spore, which has the power of withstanding a greater degree of cold than we ever experience on the whole in Natal. These peculiar spores do not, of themselves, convey the disease to other plants, but after the cold has passed away they sprout, and upon their sprouts minute spores (a third form) appear. These spores, it was shown, would not convey the disease to forage (oats), but, if they alighted upon a plant of the genus *Rhammus*, they there took root and set up an entirely different disease or fungus growth, and this fungus growth produced spores which would only take root and grow upon the forage. It was shown that the disease went through four phases, and one occurred upon an entirely different plant to the oat.

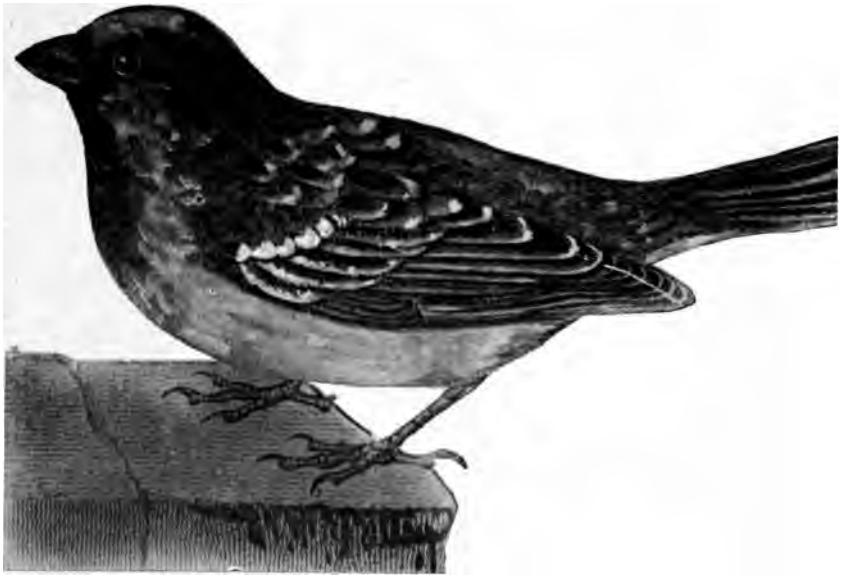
Now, with regard to this Rhubarb Blight, it is only necessary to point out that it is a stage in the life-cycle of a rust fungus very similar to that attacking oats. This rust fungus only grows upon a reed (Umhlanga), known technically as *Phragmitis communis*; a reed which is common all the world over, and found on the banks of our rivers, lagoons and swamps from the Coast to the Highlands (5,000 feet).

In the summer the blight is found on the reeds in the red or rust stage (see Plate V., Figure 3), and during the autumn the rusty patches begin to produce black spores (teleuto spores, see Plate V., Figure 6) instead of red ones. Then, as everyone knows, the reeds die off to a great extent, particularly where there is frost. These black spores are not thrown off as are the red, but they remain embedded in the dead and dry reed stalks. When spring approaches they then produce spores (see Figure 6). The spores are discharged into the atmosphere and, alighting upon Rhubarb or dock leaves, germinate and produce the disease in the cluster-cup form which has already been described. The disease is only apparent to any great extent upon the Rhubarb for a few months, and the spores escaping from the Rhubarb and alighting on the reeds, there germinate and give rise to the red-rust stage again.

The cycle of development is roughly cluster-cup stage on Rhubarb in spring, red rust stage on reeds throughout the summer, black rust on reeds through winter, and then the Rhubarb stage again.

From this it is seen that the presence of the reed in proximity to the Rhubarb field is essential to an outbreak of disease. In the absence of the reed no disease should appear. Nor does it. I have examined many Rhubarb plants in various parts of the Colony, and nowhere else have I seen this disease except at Rosetta. There the

PLATE VI.



THE ENGLISH HOUSE SPARROW.

eds were growing on the border of the field of Rhubarb, and practically all the stages of the fungus on both plants were observed. It s suggested to Mr. Acutt that if the reed-beds were carefully burnt as often as a fire could be got amongst them the disease would her disappear entirely, or it would become so trivial that its effect uld be unnoticed. I am given to understand that the destruction the reeds has had the desired effect.

THE ENGLISH, OR HOUSE SPARROW.

Passer domesticus, Linneas.

(Plate VI.)

The presence of this pestiferous bird in Durban, and the certain dications of its increase since April, 1902, when Mr. J. D. S. Woodard called attention to it, are sufficient reasons for introducing me notice of the bird into this report. Apart from that, since I ve become acquainted with its establishment at the Port, I have nsidered it my bounden duty to urge its extermination upon all d sundry. The sparrow is receiving the same apathetic attention re that it has received elsewhere whilst it is establishing itself in a w field and under fresh conditions and circumstances.

The circumstances of its introduction are similar to other cases, d can only be described as "the mistaken enthusiasm for things nglish." I gather that a few birds were imported by a gentleman Durban some six years ago. These he kept in captivity for some me, and then, because their chattering was such a nuisance, they ere turned at large.

The situation at present is this: The English sparrow, which ust be classed amongst the worst of vermin, is now established in urban, but so far does not extend to the rest of British South frica. Nothing to control its increase and spread is being done, d the question is whether we in Natal are to sit idle and allow the st not only to become a nuisance to ourselves but a menace to the st of the Colonies.

I know there are arguments against the extermination and deruction of sparrows. They are all the same and have been used er and over again, but they are mere platitudes of senseless and norant or unobservant people. The case for and against the bird s been fought out again and again. It has been argued before lect Committees of the House of Commons and before those of lonial legislatures. It has been argued by many scientific men many lands, and in every case the weight of evidence has been ainst the sparrow, and the verdicts such as to warrant this Colony taking every measure to suppress the birds altogether, at once and any cost.

Some of the arguments which were originally advanced a peared sensible, and were based on the fact that for a few weeks t nestlings are fed upon insects. But hundreds of investigations b practical, by popular and by scientific men proved that these we vain; they found that the good done in this direction by the sparro was infinitesimal in comparison to the harm. Of the argumen which have been advanced in Natal, I will say nothing; they a too absurd to take up one's time considering.

It is sufficient to say that the Sparrow is a bird which flourishe from the heated tropics to the frozen Arctic regions.

DESCRIPTIVE.

Most of us who have been beyond the broad lands of South Africa know sufficiently well the English, or House Sparrow (*Passer domesticus*), but for the information of those who have not the following is submitted:—Adult male: length, 6 inches; wing, 3 inches; bill, bluish-black; legs, pale brown; the spaces between the eyes and the bill, black; a narrow streak of white over each eye; crown, nape and lower back, ash-grey; region of the ear coverts, chestnut; back, chestnut brown streaked with black; wings, brown, with a bar of white on the middle coverts; tail, dull brown; throat and breast, black, sometimes suffused with bright chestnut; cheeks and side of the neck, white; belly, dull white. In winter the colours are duller, and the bill is yellowish brown. In the female the upper parts are striated with dusky brown; there is no black on the throat or grey on the crown, and the under parts are brownish white. The younger bird is deeper brown both above and below; the middle wing-coverts are tipped with buff; the bill is dull yellow.

The eggs are pale bluish-white, blotched, speckled or suffused with ash and dusky-brown and black; measurements, 9-10ths by 6-10ths inch. The nest is of straw, hay, dry grass, and all sorts of odd materials; thickly lined with feathers; placed indifferently in trees, climbers, in the eaves of houses and other odd places.

According to Saunders*: "The House Sparrow is generally distributed throughout Great Britain and Ireland wherever human habitations are to be found. In proportion, as land is brought under cultivation, the Sparrow makes its appearance and rapidly increases, so that it is now established in the Inner Hebrides, the Orkneys, the Shetlands, and other places where it was formerly unknown. In Scandinavia it occurs, in suitable localities, up to and beyond the Arctic circle . . . eastward it can be traced across Russia and along the inhabited portions of Siberia to Dauria; but not to Japan or China. Westward, the House Sparrow occurs in Madeira. In Africa it is found from Morocco to the Albert Nyanza, while it swarms in South Arabia and at Aden. Introduced like the rabbit,

* "Manual of British Birds." Howard Saunders, London, 1899.

ɔugh officious ignorance, in Australia, New Zealand and the ited States, it has become such a curse that special legislation has n loudly invoked for its destruction."

AS A NUISANCE.

In England:—In England the annual loss from the House arrow is estimated at three-quarters of a million sterling. We d the Board of Agriculture branding it as "a serious pest of far- r and gardener alike," and recommending its extermination or sup- ɜssion as far as possible. Before the Select Committee of the ɔuse of Commons, mentioned above, voluminous evidence was taken garding the Sparrow. From the mouths of witnesses I select a w unclassified remarks:—

1. "The great objection I have to Sparrows is that they are exterminating the martins. . . . Sparrows are the best allies of flying insects. . . . No bird, in my opinion, does as much mischief as the Sparrow. . . . The Sparrow is not only the greatest corn-eater of any of the small birds, but he is not kept down by cold winters."
2. "Any law to protect Sparrows, if at all observed, would have precisely the same effect as offering a reward for the destruction of martins."
3. "The House Sparrow stands in a class alone, it can hardly be considered a wild bird; it is a parasite living on our produce."
4. (Lord Lilford): "The Sparrow is mischievous in every way."
5. "I can hardly describe the harm the Sparrow does to me; he does harm in every possible way. *He is utterly bad.*"
6. "It is scarcely possible to say too much against these obnoxious birds."

In Australia:—The Sparrow nuisance is too notorious in Aus- ılia for any one to ignore. It has become established in every rt, even tropical Queensland. The damage it does is enormous, t so firmly established has it become in the course of some 20 ars, from the liberation of a few cage birds, that any steps to sup- ɜss it are now looked upon as hopeless.

In America:—In the United States the English Sparrow is ɜcribed as a serious problem in economic science, particularly so as the whole agricultural interests are concerned in their most nprehensive sense. Nowhere has greater attention been paid to as a pest than here, and I have before me a report on the subject ʳering over 400 pages and dealing with every aspect of the ques- n*. From this report we learn that the first Sparrows were in- duced in America in 1850. For a long time the attempts to estab- ı the bird were unsuccessful, but in the course of 25 years, dur-

* "The English Sparrow in America." Merrian, 1899.

ing which Sparrows to the number of 1,631 were introduced to 15 places directly from Europe, they were spread purposely to 92 towns. This was about 1870-75, and from then up to 1888 the birds multiplied with marvellous rapidity. "Some idea of the alarming rapidity with which it is at the present moment multiplying and extending its range may be had from the fact that in the United States alone it has spread during the past 15 years (1873-88), at an average rate of 59,000 square miles per year."

The rate of increase of the Sparrows is remarkable. Merrian says: "Its fecundity is amazing. In the latitude of New York and southward it hatches as a rule five or six broods in a season, with from 4—6 young in a brood. Assuming the average annual product of a pair to be 24 young, of which half are females and half males, and assuming further that, for the sake of computation, all live together with their offspring, it will be seen that in 10 years the progeny of a single pair would be 275,716,983,698.

Everywhere, in England, in America and Australia the Sparrow has proved itself an enemy of insectivorous birds. In Pennsylvania the native birds rapidly and steadily diminished in numbers with the advent of the Sparrow. The bird was introduced into certain towns in America with the hope that it would rid the elms and shade trees of the caterpillars which annually defoliated them. The utter futility of this hope is demonstrated in hundreds of cities and towns which are overrun with Sparrows and where the trees are repeatedly defoliated by worms. In New York it was found that the Sparrows actually protected the caterpillars of the tussock moth from their other enemies, and led to an extraordinary increase of the pest.

The following is the list of sins arrayed against the Sparrows:

1. They cause incalculable injury by driving away useful birds of insectivorous habits and by destroying their young.
2. They cause injury by the filth they produce.
3. They directly injure buds, blossoms, and foliage of trees.
4. They attack all fruits, viz., peach, pear, grape, plum, cherry, apple, apricot, orange and fig, attacking buds, blossoms and fruit.
5. They are directly injurious to vegetables, particularly peas and young lettuce and cabbage.
6. Grain crops such as wheat, oats, barley, rye, buckwheat, amabele, rice and imphee suffer from them seriously from the time of sowing until the grain is stored.

CLAUDE FULLER,
Government Entomologist.

APPENDIX A.

[o. 45, 1904.]

HENRY BALE,
Administrator.

ACT,

"To prevent the Introduction and Spread of Disease in Plants."

E IT ENACTED by the King's Most Excellent Majesty, by and th the advice and consent of the Legislative Council and Legis-ive Assembly of Natal, as follows:—

1. This Act may be cited as the "Plants Diseases Act, 1904."

2. Law No. 15, 1881, entituled Law "To regulate the introduc-n into this Colony of Plants or Cuttings, which by reason of Dis-se, or otherwise, might be injurious to the interests thereof," is reby repealed, without prejudice to any proclamation, order, or gulation made thereunder, all of which shall continue in force until voked by a proclamation, order, or regulation under this Act.

3 In this Act:—

"*Plant*" means any tree, shrub, or vegetation, and the fruit, leaves, cuttings, bark, and any part or product thereof whatsoever, whether severed or attached.

"*Disease*" means any of the insect pests or plant diseases mentioned in the Schedule of this Act, and any insect pest or plant disease which the Governor in Council may by proclamation declare to be a pest or disease within the meaning of this Act.

"*Diseased*" means affected with such disease; and

"*Healthy*" means not so affected.

"*Nursery*" means any land or premises whereon are grown any plants intended for sale or distribution for the purpose of being grown elsewhere.

"*Orchard*" shall mean any land or premises where are grown and cultivated any fruit-bearing plants or trees, and extends to and includes a garden or vinery.

"*Minister*" means the Minister of Agriculture.

"*Board*" means the Honorary Board of Advice.

4. The Minister may from time to time appoint Inspectors and other officers necessary for the carrying out of this Act.

5. The Minister may, from time to time, appoint an Honorary Board of Advice, consisting of five members, of whom one shall be the Government Entomologist, and the others representative fruit farmers and nurserymen. Such Board of Advice to exist at the pleasure of the Minister, and the members thereof to receive no fee or reward for their services, save only travelling expenses. The functions of the Board to include advising the Minister with regard to:—

(*a*) Prohibiting or restricting the importation of plants, and their removal within the Colony from place to place.

(*b*) The framing of rules and regulations under this Act.

(*c*) What pests and diseases shall be brought under the provisions of this Act, and regarding the administering of the Act generally.

6. The Governor may from time to time, by Proclamation, prohibit the introduction into Natal of any plant which may be considered likely to introduce any disease. Such Proclamation may either be absolute or subject to such conditions or exceptions as may seem proper, and may apply to the introduction of plants either generally or from any specified place.

7. The Governor may from time to time, by Proclamation, on the advice of the Board, order that all plants in nurseries throughout the Colony which may be affected with any specified disease shall be destroyed, or that they shall be isolated and treated in any specified manner.

8. The Governor in Council may, from time to time, make and alter regulations for all purposes necessary for carrying out this Act, and for giving full effect thereto. Such regulations may, amongst other things, prescribe the conditions under which plants may be introduced into this Colony; the duties and authority of inspectors or other officers, and the mode and means of carrying out and enforcing the provisions of this Act or of any proclamation or order.

9. Every nursery shall be registered by the occupier thereof at the office of the Magistrate of the Division on or before the 31st day of January in each year.

10. An Inspector may at all reasonable times enter a nursery or orchard, with his assistants, for the purpose of making an inspection or carrying out any other duties therein.

11. The Minister may, on the advice of the Board, make an order requiring the occupier of a nursery or orchard to take, within a specified time, all such measures for the eradication of diseases as may be prescribed in the order. The Minister may in like manner make an order placing any nursery or orchard under quarantine.

12. So long as an order of quarantine applies to a nursery or orchard, it shall not be lawful to remove any plant or any part or product of a plant therefrom, except with the permission and under the direction of an Inspector, and the occupier shall comply with all instructions contained in the regulations or specially prescribed by an Inspector, with the approval of the Minister, for eradicating or preventing the spread of the disease.

13. The occupier of every nursery shall provide proper and approved chambers for fumigating with hydrocyanic acid gas, and it shall be his duty to fumigate all plants immediately before delivery in accordance with the regulations.

14. No person shall send out from a nursery any plant affected with disease. If any plant is so sent out, the occupier of the nursery, as well as every person actually ordering or superintending the sending out of such plants, shall be deemed guilty of a contravention of this Act.

15. Every nurseryman selling plants shall be deemed to have warranted the same as being free from disease, and he shall not be entitled to receive or recover payment for any plant which may be so diseased: Provided that no defence or claim for the restitution of price, other than such as would be maintainable if this Act had not been passed, shall be competent to a purchaser unless he shall show that he gave written notice of such disease to the vendor or his agent, either delivered personally or by telegram, or sent by registered post within three days next after the day on which the plants actually reached the purchaser.

16. When any disease considered by the Minister, on the recommendation of the Board, to be a source of danger is prevalent in any nursery, orchard, or fruit garden he may, if he deems such a measure necessary in order to prevent its spread, order the special treatment and, if necessary, the destruction of any specified kinds of plants therein, whether such plants be diseased or not: Provided that compensation shall be paid for healthy plants so destroyed. The amount of compensation shall be fixed as provided for in this Act.

17. Any Inspector appointed under this Act or any officer of the Customs may seize any plant which is being imported into the Colony and which is suspected of being affected with disease; and any Inspector may inspect the same and require it to be disinfected to his satisfaction, and if he is satisfied that it is diseased, and that the disease cannot otherwise be satisfactorily eradicated, he may have the plant destroyed, together with any box, basket or package in which it has been packed. An Inspector may similarly seize and deal with any plant which may be found in transit or exposed for sale in the Colony or which is being sent out from a nursery, and appears to be diseased.

18. No person shall be entitled to receive any compensation

whatever for the destruction of plants ordered to be destroyed on account of disease, except that where healthy plants are ordered to be destroyed as a measure of precaution, the owner shall be entitled to receive payment of their value from the public revenue. Such value shall, unless agreed, be assessed by two persons chosen by the Inspector and the owner respectively, and failing agreement between them, it shall be determined by the award of a competent person mutually chosen by the assessors.

19. No Inspector and no person acting under the direction or order of such Inspector shall be deemed to be a trespasser by reason of any entry or destruction under this Act, or be liable for any damages occasioned by carrying out the provisions of this Act, unless the same were occasioned maliciously and without reasonable cause.

20. Every owner of plants, nurseryman, or occupier of premises, and every person representing him, or having charge of any plants or premises under him, shall be bound to obey all lawful orders made by the Minister or by an Inspector, and shall give the Inspector every assistance in carrying out such order, or shall himself carry it out if so required.

21. Any obligation placed by this Act upon the occupier of a nursery or other land shall in his absence or default, or if there be any doubt as to who is to be considered as the occupier, be equally binding upon every person having the charge or superintendence of such nursery or land.

22. Every person shall be guilty of a contravention of this Act who:—

(*a*) In any manner obstructs or impedes any person in the execution of any of the powers conferred by this Act or refuses any assistance which he is required to give; or

(*b*) Disobeys or neglects to comply with any of the provisions of this Act or the terms of any regulation, order, or proclamation made thereunder.

23. All persons contravening this Act, or any regulation or lawful order made thereunder, shall for each offence be liable to a penalty not exceeding Twenty Pounds (£20) Sterling, to be recovered in the Court of a Magistrate by the Clerk of the Peace or by an Inspector or other proper officer of the department.

24. This Act shall not come into force until six months after the promulgation of the same in the *Natal Government Gazette.*

SCHEDULE.

Insect Pests.

Codling Moth (*Carpocapsa pomonella*).
San Jose Scale (*Aspidiotus perniciosus*).

Pear Slug (*Selandria cerasi*).
Cape Fruit Fly (*Ceratitis capitata*).
Apple Mussel Scale (*Mytilaspis pomorum*).
Orange Mussel Scale (*Chionaspis citri*).
Parlatoria of the orange (*Parlatoria ziziphus* and *Parlatoria Pergandei*).
Glover's Scale (*Mytilaspis gloveri*).

PLANT DISEASES.

Orange* Yellows and Peach Rosette.
Crown Gall.
Fusicladium of the Apple.

Given at Government House, Natal, this Nineteenth day of August, 1904.

By command of His Excellency the Administrator,

THOS. WATT,
for Colonial Secretary.

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* Misprint; read Peach Yellows, etc.

REPORT ON THE DESTRUCTION OF LOCUSTS.

SEASON 1903-1904.

THE reports of flying swarms of locusts, which commenced reaching this office about the first week in September, 1903, and later the reports as to the depositing of eggs, both in Natal and Zululand, gave but a poor idea of the heavy work the Department had to face during last season. From past experience it was fully anticipated that the coast belt would again be the favoured locale for the laying of eggs, and steps were taken to combat the pest, as soon as the "hoppers" made their appearance. The first District Locust Officer was appointed on the 15th of December, 1903, for a portion of the Lower Umzimkulu Division. Further appointments were made for both north and south belts, between the last week in December and the first fortnight in January, 1904.

The work had scarcely begun in earnest in this portion of the Colony before it became apparent that the hatching season would be an exceptionally heavy one. Numerous reports kept reaching the office to the effect that young locusts were hatching out in various districts, even so far north as Dundee and Newcastle. It was found impossible to cope with the rush of work thus entailed, and it became necessary to appoint an Assistant Inspector, Mr. C. Meyerheim, to supervise the work in the up-country Districts. Clerical assistance had already been engaged to attend to the routine work, but this proved quite inadequate at this stage of the season, and but for the Ministerial staff coming to our assistance the work would have become so delayed as to cause serious inconvenience and confusion. As it was, the assistance came too late in the day to keep the accounts and the payment of the same up to date.

It must be borne in mind that the season in which it is practicable to destroy the "hoppers" is a comparatively short one, and, taking into consideration the fact of the number of reports daily received at the office, all urgent and all requiring individual attention, it is satisfactory to note the expeditious manner in which the work was carried out, entailing as it did several hours' overtime each day. It was necessary, as the reports came to hand and the Districts infested included Crown lands and Native locations, to appoint suitable men as District Locust Officers to take charge of the work.

Dependence had to be placed, to a great extent, on the recommendation of the District Magistrate, or some well-known individual in the neighbourhood, as, time being an important factor, it was impossible to interview applicants for the posts, prior to making appointments. Taking this fact into consideration, and also that at one time or other of the season there were 87 officers employed, it is a matter for con-

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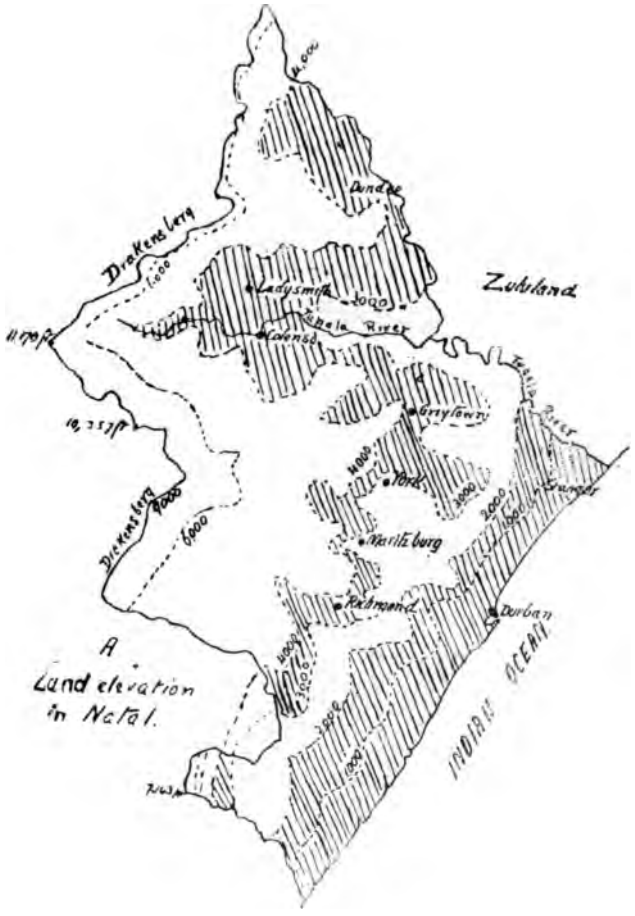

A
Land elevation
in Natal.

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B
Locust Zones
in Natal

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CALIFORNIA

ıtulation that the men carried out their duties in such a satisfactory ınner. Where the work was being carried on in Native locations the ıiefs were instructed through the Native Affairs Department and the stricts Magistrates to render every assistance in their power, without muneration, except when Natives in their own location were turned ıt to assist the officer in charge, when they were supplied with food ıring the days on which they were so employed. The Natives evinced ore readiness to co-operate in the work of destruction this season than ı the previous year, although considerable difficulty was experienced y some of the officers, until the Native Affairs Department took the ıatter in hand, and issued certain instructions from that office.

The question of Native pay will always be one difficult to adjust. .s before stated in an earlier report, the nearer the sphere of labour is ɔ the large towns, Pietermaritzburg and Durban more particularly, the ɡher the rate of wage becomes. It was necessary in some cases to pay ‹atives as much as 2s. 6d. per diem, whereas in the more remote Districts he rate of pay rarely exceeded 1s. 6d. per diem, and 1s. a day has been nown to be willingly accepted.

The method employed for the destruction of the locusts was ›ractically the same as that adopted in the previous season, the arsenic olution being found quite as efficacious as heretofore. It was found ıecessary, however, as the hoppers increased in size and strength, to ıix the solution accordingly, and add a larger proportion of arsenic. t may not be out of place to give here the proportion of the ingredients enerally accepted and pronounced effective.

Arsenic Solution.

1 pound of arsenic.
½ do. of washing soda.
4 to 6 pounds of treacle or common sugar.
16 gallons of water.

oil the ingredients for a quarter of an hour in two gallons of water, then ld the remaining fourteen gallons of cold water.

To strengthen the solution, one and a half pounds of arsenic to ıree quarters to one pound of washing soda, should be used with the ıme quantity of water as mentioned above.

The question of water supply has and always will be a difficult pro- em to solve, more especially in the inland Districts. This difficulty ıs obviated to a great extent by the use of carts and oxen with tanks, r the purpose of carrying the water to the scene of operations. Even th this assistance there were many localities swarming with hoppers, ıere it was impracticable to take a cart, and the sole supply of water d frequently to be carried long distances by Natives, which entailed ɔonsiderable waste of time, and the supply so obtained fell far short what was actually required. This is one of the great drawbacks that ɜl to be met with, and, so far, no solution of the difficulty has been ınd. So long as the adult locusts deposit eggs in waterless and rugged ıntry, so long will the work of destruction be hampered, and in con- ſuence the locusts attain the flying stage before they can be destroyed. ass fires were utilised wherever occasion offered, and a very large rnber of swarms were destroyed in this manner, although in the

majority of cases it was found necessary to drive the locusts into grass sufficiently high and dry to burn readily, large numbers of Natives being called into requisition for the purpose.

As the locusts approached the flying stage it was observed that during the heat of the day the swarms became very scattered, and spraying was of little or no use. This portion of the day was therefore utilised for the preparation of the solution, and spraying operations which were commenced as soon as it was light, were discontinued during the middle of the day, and carried on again during the afternoon and evening. By this method the swarms were easily destroyed, as they pack towards the afternoon and do not disperse until the sun has been up for some time.

The herbage so sprayed with the arsenic solution dies off in a few hours, but apparently the roots always remain uninjured, as after a few weeks have elapsed fresh shoots appear, and the sprayed portion assumes its normal aspect; if anything, rather benefiting than otherwise from the application. Several planters on the coast spray over their sugar cane, when unable to destroy the pest outside the fields, although it has been reported that there are some exceptions to this plan, who either refuse to use arsenic solution at all, or who, if they do, distribute it in such a fashion as to render the labour practically useless.

It is safe to state that the proportion of the intelligent public who recognise the necessity and the benefit to be derived from the destruction as far as possible of this serious pest, must be fully 85 per cent. Time will, let us hope, convince the remaining 15 per cent. that the plan adopted so successfully in the last two seasons is the best that we have knowledge of to date. When comparison is made between the arsenic treatment and some methods that have come under notice, it is marvellous that so much time should be wasted. When coolies are sent into the cane fields and endeavour to shake the hoppers from the cane into tins, presumably with the purpose of ridding the crop of the pest, it would seem that some more stringent law is badly needed. If the owner or responsible person, under whose orders such action is taken, were the only loser from the ravages of these insects, but little could be said, save that the policy adopted does not recommend itself to the average intellect, but he is not the only sufferer, and his neighbours are bound, sooner or later, to have unmistakable evidence, in the loss of their own crops, of such a feeble attempt to deal with a question which concerns the welfare of the farming community throughout the country. The new Locust Act No. 40 of 1904, now in force, both in Natal and Zululand, embodies the principal features of the three preceding Acts which it supersedes, and also contains certain clauses which tend to strengthen the hands of those administering the law. One clause in particular, number 15, which provides for a penalty of fifty pounds, or, as an alternative, six months, with or without hard labour, to be inflicted on persons wilfully driving young locusts off their own property on to any neighbouring property, fills a much-needed want. That such action could be taken by any right-minded owner seems hard to believe, but nevertheless such was the case in some instances during the locust campaign. Unfortunately the late Acts made no provision against persons adopting this method of clearing their lands at the expense of their neighbours. Now, under the new Act, action will be promptly taken should such practises be indulged in.

The question of the absentee landlord was also a vexed one, it being extremely difficult to find out the responsible person with whom to deal. This difficulty is met by Clause number 3, wherein "owner" includes the person holding land under lease from the Crown and the purchaser of Crown lands not yet transferred. "Owner and occupier" includes joint owners or occupiers, and the agent or manager of an occupier or owner.

The question of the policy of the Government taking up the work of locust destruction in the hopper stage is one that the public are likely to give an opinion upon. If the work of last season had been left to individual endeavour the result would have been truly disastrous. The saving in crops has been most satisfactory, but the work was undertaken, in a large number of cases, under the management of officers appointed by this Department. The question of expenditure, which was heavy for a young country like Natal, was fully justified by results. About eight thousand pounds were spent during the season, and when it is taken into consideration that as much as fifty thousand pounds per annum is expended in the endeavour to combat the pest in countries in the north of this continent, it appears that not too much is being done by the progressive community of Natal. At one time or another 87 officers were employed by the Department, details of which will be found in the schedule attached to this report. This will show an average of about £103 10s. per officer. The amount expended in the season 1902-1903 only amounted to the sum of one thousand six hundred and fifty pounds, and the total number of officers employed at any one time was fifteen.

The matter of estimating the cost of a campaign of this nature is almost an impossibility, seeing that the last two seasons differ so widely in expenditure, and, as already stated, the individuals most interested were extremely lax in the matter of reports, until the hoppers appeared on their own property, when the Department was expected to meet all demands that reached the office daily, and to have made earlier arrangements to meet the same.

As stated in my first report, there still seems a tendency on the part of certain members of the community to leave the Government to bear the brunt of work taken in hand, which they, as landowners or occupiers, should take upon themselves, being the persons most interested and reaping the greatest benefit. It would be interesting to hear what cry would have arisen, during the season just past, had the Government not taken any action in this work of locust destruction.

To say what amount in actual money value was saved is a matter that would entail a very careful scrutiny of the crops, and an unbiassed valuation of their marketable value. In several instances, in the case of Natives, thanks have been tendered for the work done in locations, but there again officers of the Department were in charge of operations, and called upon the Chiefs for assistance for the purpose of carrying water, or assisting in the destruction of the young locusts by means of grass fires. It has been stated in certain quarters that the money expended by Government in the destruction of young locusts, on Crown lands and Native locations, should have gone to the assistance of the white farmer. Had this course been pursued it would have meant that both the farms occupied by white holders and also the locations would have had to be cleared at Government expense.

As has been stated before, the original complaints were from those owners of land in close proximity to Native locations, asking that such locations should be cleared, as far as possible, in order to give protection to private owners, such as sugar planters who took the onus of clearing their own lands. This was done, as far as possible, and the satisfaction expressed seemed to be sufficient proof of the utility of the enterprise. There are still those who imagine one season's campaign against locusts should ensure the country from any further visitation. The history of the natural world will furnish an ample refutation to such a conception. The average amount expended per annum on this work should be proof of the good results, if it be taken into consideration the fact that during the season just passed over fifty-five thousand swarms were destroyed by the officers employed by Government, irrespective of private endeavour.

LOCUST DESTRUCTION.

SEASON 1903-4.

VOTE XXXII.		Estimate. £ s. d.	Expended. £ s. d.
D 4.	District Locust Officers:		
	Main Estimate ...	1,500 0 0	4,438 1 8
	Supplementary ...	2,550 0 0	
	Amount over-expended ...		388 1 8
D 5.	Temporary Natives:		
	Main Estimate ...	200 0 0	1,238 19 2
	Supplementary ...	1,650 0 0	
	Amount under-expended ...	611 0 10	
E 3.	Transport, etc.:		
	Main Estimate ...	200 0 0	763 17 9
	Supplementary ...	400 0 0	
	Amount over-expended ...		163 17 9
E 4.	Miscellaneous:		
	Main Estimate ...	600 0 0	1,555 12 0
	Supplementary ...	600 0 0	
	Amount over-expended ...		355 12 0

	£ s. d.
Votes D 4, D 5, E 3, and E 4 ...	7,700 0 0
Excess Expenditure	296 10 7
Expenditure	7,996 10 7

The 87 officers appointed worked on an average 63 days each, making a total of 5,481 working days, the cost of destruction per swarm being close on 2s. 9d. In taking these figures into consideration one must bear in mind that whereas the campaign last season was carried on over a very much smaller area, this season it practically embraced the greater portion

of this Colony and Zululand. Again the facilities which were afforded the work in 1902-1903 could not reasonably be expected during 1903-1904. Take the question of transport for one instance. The amount expended last year was under twenty pounds, this year over seven hundred and sixty. The great difficulties experienced were in getting material from rail to destination, and then continually having to trek over the roughest country, as fresh infested areas were reported. The water question I have also touched upon, but here again the question of comparison comes in. Considerably less than two hundred pounds was spent in Native labour last season. This year the cost of Natives was close on twelve hundred and forty pounds, the number employed being three hundred and twenty-four, or an average of between four to five Natives to each officer employing same. In some instances as many as from eight to ten Natives were employed by one officer, this being more especially the case when the work of destruction lay in Districts remote from locations, or populated to a great extent by Indians. The expenditure under the heading "Miscellaneous" was of necessity far heavier than last year. The figures respectively being about £400 and £1,560. Each officer had to be supplied with material to enable him to carry on his work. Even then the average compares very favourably with last year, when the amount per head was about £29, and this season it works out at a point over £18 per man, after having allowed for the stock in hand from last season.

The question of horse insurance was raised towards the latter part of the year 1903. As some few officers had lost their horses during the last campaign, and had not received compensation for them, they stated they were not prepared to again accept office without some guarantee in case of a like occurrence. The matter was submitted through the usual channels, and it was eventually decided that officers' horses could be insured on payment of the usual premiums. Twelve District Locust Officers lost their horses and received compensation for same, amounting in all to the sum of £271 10s., or an average of £22 12s. 6d. per man. It would be unfair to preclude this class of officer from benefiting under any insurance policy the Government may bring into force, seeing that his duties take him into some of the worst areas as regards horsesickness, and at the very worst time of the year. As stated elsewhere, it would prove extremely difficult to obtain reliable and suitable men for the work should this advantage be withheld.

The question has been raised by some as to the desirability of using arsenic solution for the destruction of the "hoppers." It is safe to say, after the experience of this season, that with ordinary care the process should prove harmless to man and beast. One Native lost his life owing to his stealing some of the solution and mixing it with his porridge. The officer in charge of this District where this occurred was entirely free from blame. He had already issued the poison to the Indian, who owns a farm of over 500 acres, with strict injunctions to take every precaution as to its safe custody. From that time his responsibility ended. I was personally inspecting this District, accompanied by the District Locust Officer, on the day the Native took the poison, and saw him a few hours after he was taken ill. The Indian's head man was on the spot, and had sent for the District Surgeon. The Native was not working on the

farm and had no right to enter the hut where the poison was stored. A Magisterial enquiry was held, and a report on the case forwarded to headquarters.

Two cases of the loss of cattle were reported, but the officer in charge was not to blame in either case. Common-sense must be used in dealing with this treatment, and although explanations were given as to the way the arsenic solution was to be distributed, one individual saturated a small area of ground and allowed his cattle to go on to it at once, when they licked up the mixture, with the result that he lost two of them. There is no remedy for such stupidity or carelessness as this.

EXTRACT FROM MR. C. MEYERHEIM'S REPORT.

"The following Districts were more or less infested by locusts:—Weenen, Ladysmith, Dundee, Umsinga, Krantzkop, Mapumulo, Umvoti and New Hanover. In most cases the worst infested areas were the Native locations, Crown lands and European farms tenanted bv Natives. The European farmers in nearly all cases came off very lightly, and were able to exterminate the various swarms on their lands at small expense and trouble to themselves.

"They mostly availed themselves of the materials supplied by the Government at cost price, and with the assistance of spray pumps, etc., had no difficulty in clearing their lands.

"The operations carried out by the Government officers were an unqualified success, and it is, I think, to be regretted that more farmers, who have actually gone to the trouble of personally investigating the work, have not expressed their satisfaction in print in the same terms as they did verbally. In all instances where the work was taken in hand in good time the Native crops were saved without exception. One very gratifying incident in connection with the work done in the Krantzkop Division, and showing the effective manner in which the infested area was cleared, was the fact of the Native Chief attending on the Magistrate and expressing his thanks to the Government for saving the crops, which, except for the action taken, would have been lost. The Natives on the whole rendered willing assistance in supplying water, driving and keeping swarms together, etc.

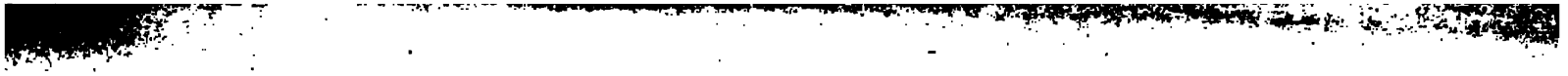
"Special thanks is undoubtedly due to the Magistrates of the various Districts for the energetic assistance they gave on all occasions, in many instances going out of their way to help to make the work a success."

There was some comment on the work of the season, as to the amount of money expended in the inland Districts, and the lands infested on both the north and south coasts. This question was carefully gone into, and it was found that the difference only amounted to a little over £200 in favour of the coast Districts.

As has already been stated, if the farming community would only recognise the fact that the Government in undertaking the work of

ust destruction is doing its best to assist the welfare of the Colony, I would in their turn do more as individuals, the general success of the dertaking would be more apparent.

W. H. BUSHBY,
Chief Locust Officer.



Fifth Report

FROM THE

VERNMENT ENTOMOLOGIST,

NATAL.

Fifth Report of the Government Entomologist.

Office of the Government Entomologist,
Pietermaritzburg, 17th January, 1906.

MINISTER OF AGRICULTURE,—

I have the honour to submit my fifth report as Government Entomologist of this Colony. A report for the Locust Campaign, 1904-5, published in June last by the Chief Locust Officer is appended.

CLAUDE FULLER.
Entomologist.

ITINERARY.

Entomologist.

1904. July 18th-19th.—Manderston. Spraying, etc., for scale insects.
August 17th.—Town Lands. Carbon Bisulphide experiments for white ants.
August 23rd.—Nursery inspection.
August 29th.—Pruning. Hilton Road.
September 4th.—Town Lands. Observations on cut-worms.
September 15th-17th.—Highlands.
September 18th.—Town Lands.
September 23rd.—Nel's Rust. Bellair.
October 26th-27th.—Farmers' Conference.
November 3rd.—Durban.
November 15th.—Zululand.
November 27th.—Town Lands. Tomato disease.
1905. December 30th to April 14th.—Brazil.
April 16th-17th.—Durban.
April 26th-27th.—Farmers' Conference.
April 28th.—Cedara.
May 30th.—Chase Valley.
May 25th.—Umlaas Waterworks. Mosquito investigation.
June 7th.—Nursery inspection. (Wilkinson and English.)

June 9th.—Hillarys. Nursery inspection.
June 16th.—Durban.

Technical Assistant.

1904. August 16th-23rd.—Somkele. Mosquito investigation.
September 7th.—Town Bush Valley.
September 13th.—South Coast Junction.
September 14th.—Hospital Siding.
1905. January 5th.—Cedara.
January 24th-27th.—Weenen.
January 9th.—Winkle Spruit Experimental Farm.
February 2nd.—Newcastle.
January 11th-12th.—Stanger.
February 4th-7th.—Glencoe Junction to Dundee.
February 7th-9th.—Ladysmith.
February 9th-11th.—Estcourt.
February 20th-26th.—Stanger and Verulam.
February 27th-28th.—Richmond.
} Mosquito Investigation.
March 13th-16th.—Stanger. Investigation of cotton insects.
March 20th-24th.—Greytown. Mosquito investigation.
March 29th.—Botanical Gardens, Pietermaritzburg. Inspection of cuttings for Transvaal.
April 6th-10th.—Esperanza. Investigation of cotton insects.
April 12th.—Belfort. Collecting Fruit Fly larvae.
April 25th-30th.—Umzinto. Mosquito collecting.
May 1st.—Durban to Reunion. Mosquito collecting.
May 2nd-5th.—Durban to Stanger. Mosquito collecting.
May 5th.—Verulam to Mount Moreland. Mosquito collecting.
May 9th.—Verulam to Ottawa. Mosquito collecting.
May 8th.—Durban to Verulam. Mosquito collecting.
May 16th.—Durban to Redhill. Mosquito collecting.
May 17th-20th.—Durban to Greenwood Park. Mosquito collecting.
June 7th.—Town Bush Valley. Nursery inspection.
June 21st.—Town Bush Valley. Nursery inspection.
June 25th.—Darnell. Nursery inspection.

Junior Assistant.

1904. July 18th-19th.—Manderston. Spraying operations.
August 17th.—Town Bush Valley. White ant experiments.
August 23rd.—Town Bush Valley. Collecting Fruit Fly larvae.
1905. January 6th to 12th—Durban. Cotton seed treatment and fumigation of the Central Gaol.
January 19th-21st.—Durban. Cotton seed treatment.
April 5th.—Manderston. Spraying operation.
April 12th.—Balgowan. Collecting Fruit Fly larvae
April 17th-18th.—Durban. Cotton seed treatment.
June 7th-10th.—Estcourt. Agricultural Show exhibit.
June 21st-24th.—Ladysmith. Agricultural Show exhibit.

FRUIT FLY PARASITE INVESTIGATIONS.

From the beginning of January to the middle of April I was absent from the Colony upon this inter-colonial undertaking. I should like to point out here that, exclusive of my salary, the cost of this undertaking to Natal amounted to £126, or a little more than one Natal fruit-grower was prepared to contribute towards the investigation, whether a success or otherwise.

Upon this matter I have already reported, and a very lengthy and comprehensive report has been submitted by my colleague, Mr. C. P. Lounsbury, the Cape Entomologist. As our work and observations were, to a great extent, independent of each other, it is at least satisfactory that in the conclusions arrived at there is no difference of opinion. Indeed, whilst my colleague's report is no less to the point than my own, it can only be said of it that it is not so bluntly worded, and naturally covers a much wider field of observation.

In connection with this investigation, there is little further to be said, which may be summed up as follows:—

1. There exists in Brazil a minute wasp (*Opiellus trimaculatus*) which parasitizes and destroys the maggots of the Bahia fruit fly (*Anastrepha fratercula*).

2. The effective parasitism of this species reaches its maximum in small fruits with thin pulp; and the effectiveness falls appreciably in proportion to the depth or thickness of the pulp of the fruit attacked by this fruit fly.

3. Consequently, the parasite, on these grounds alone, does not promise any efficiency so far as the fruits of our local orchards are concerned.

4. Again, despite its presence, the prevalence of the species which it affects is greater in Bahia than that of the fruit flies in South Africa.

5. Further than this, absolutely no evidence was obtained, or has since been obtained by qualified local investigations, to show that the wasp-parasite ever attacks the larva or maggot-stage of the South African fruit fly (*Ceratitis capitata*).

6. There exists in Brazil a Staphylinid beetle which preys upon the larvae or maggots escaping from fruit or in fallen fruit.

7. With regard to this insect, there is ample evidence that it is only of periodic occurrence, and does not appreciably affect the ascendancy of fruit fly attack.

So far as the investigation is concerned, the amount of time it occupied considerably affected the course of work outlined for the year, and it was a matter of great regret to me that I was absent throughout the whole Locust Campaign 1904-5.

CORRESPONDENCE AND PUBLICATIONS.

During the year 888 letters and telegrams were despatched and 696 received. This does not, of course, include official papers, nor the correspondence of the Chief Locust Officer.

The publications of the office have only taken the form of contributions to the *Agricultural Journal*, a tabulated list being appended.

Title.	Form.	Issue.	Pages
Carbon Bisulphide, its nature and uses* ...	Article	September	Vol. VII., 839-845
Microscopic Mites ...	Article, Illustrated	„	„ 849-866
Cotton Insects and Fungus Blights ...	„ „	October ...	„ 931-944
Red Ants	Correspondence ...	.. ...	„ 983-4
Collar Rot	A Criticism ...	November	„ 1041-1050
The Bahia Orange ...	Article	April ...	Vol. VIII., 330 334
Natural Enemies of the Fruit Fly	Report	May ...	„ 443-448
Fumigation of Dwelling Houses for Vermin* ...	Article	„ ...	„ 457-464
Nursery Fumigation* ...	Article, Illustrated	June ...	„ 533-540
Locust Destruction ...	Report 1904-05 ...	„ ...	„ 559-562

Separate copies of those marked with an asterisk can be obtained by farmers on application to this office.

During the year letters of advice were sent out in reply to enquiries addressed to this office upon the following variety of subjects:—

Pruning of fruit trees and general orchard matters.

Treatment of moles, dodder, and the following fungus diseases:—

Anthracnose of the Vine.
Mildew of the Vine.
Mal-di-Goma or Root Rot.
Quince Knots.
Lucerne Fungus.
Lemon Scab or Verrucosis.
Geranium Rust.
Potato Blights.
Mealie Smut.
Pea Rust.
Cane Spume.
Shot-hole Fungus.

The Entomological correspondence dealt largely with locust destruction, the treatment of white ants and uses of Carbon Bisulphide, the treatment of citrus scale insects and fumigation and spraying to control such, the treatment of granary pests, bed bugs in houses, and the following miscellaneous insects:—

Bollworms or Beard Grubs of Mealies.
Cabbage and Turnip Aphis.
Orange Aphis.
Scale infestation of Amatingulu.
Ticks.
Mange in Cats and Dogs.
Acacia Beetle chafers.
Acacia Caterpillars.
Rat-tailed Maggots.
Mosquitoes.
Mango Weevils.
Cockchafer Grubs in Strawberry Beds.

Queen Bees.
Lantern Flies.
Citrus Psylla.
Horse Bots.
Blister Beetles.
Fruit and Flower Beetles.
Peach Aphis.
Fig Beetles.
Cut-worms.
Totofiana Locusts.
Orange Caterpillars.
Australian Bug.
Spittle Bugs.

PLANT DISEASES ACT No. 45 OF 1904.

Under Clause 24 of this Act it was specially provided that the Act should not come into force until six months after its promulgation. This fixed the date at February 23rd, 1905. Owing to my extended absence in Brazil it was found impossible to accomplish anything in connection with the provisions of the Act. It is well to point out here that the main principles of this Statute are: 1. To provide powers for the eradication of any injurious pest which may become introduced into the Colony and to prevent its general dissemination at once. Its necessity in this connection may be easily illustrated. For example, three injurious insects, although already introduced into nearly every fruit-growing country in the world, are not yet known to exist in Natal; I refer to San Jose Scale, Codling Moth, and the Pear Slug.

Concerning the first, it may be pointed out that about 15 years ago a number of infested trees were imported by a New South Wales nurseryman from America, and by this agency the disease was disseminated throughout the Colony. Subsequently it was further distributed upon trees imported directly from Japan. In 1898, eighteen infested areas were recorded.* I feel confident that if, at the time the pest was introduced, the Colony of New South Wales had the necessary legal powers, that it could have been stamped out, or, at any rate, its spread effectively controlled and limited.

The Codling Moth has been established for some years in the Western Province of Cape Colony, and has from a few centres gradually and persistently advanced until quite a large area is now infested. Whilst entomologists who have studied the control of this pest of the apple seem agreed that, once it has obtained a foothold, its extermination is impracticable, one has no hesitation in affirming that had the Cape authorities possessed the needful legislative powers the Codling Moth would not have extended its range as it has done, and it would have been now thoroughly under control, instead of a constant and increasing menace to an important industry.

The Pear Slug is not so important a pest as the two above-mentioned, but it is an equally useful illustration. If this insect were introduced it would rapidly spread throughout the Colony.

I have dealt with this principle at length, because I wish it to be understood that it is not intended to make the working of the Act of a harsh and arbitary nature so far as farm orchards are concerned.

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* Froggart, W A. Agricultural Gazette, New South Wales, 1898.

It is well to point out, however, that there are some cases (where the fruit industry of the Colony is hampered by the neglect of growers to take ordinary measures to control pests) which demand attention. This obtains chiefly in the immediate vicinity of Maritzburg and Durban, and it may soon be necessary to enforce the provision of the Act in those districts in order to suppress the insect pests of citrus trees.

The second principle was to provide against the dissemination of insect pests from local nurseries. Viewed as an earnest of what the nurserymen will accomplish after the Act comes into operation, what has been done in anticipation thereof, is most satisfactory.

Nurserymen generally are quite in sympathy with the work, and the more progressive see its advantages.

Upon previous occasions I have charged our nurserymen with distributing insect pests throughout the Colony; indeed, I am of the opinion that if their work had been gone about with the idea of spreading troubles it could not have been better accomplished than it has been in certain cases. I do not wish it to be inferred that I think this distribution of pests was done with *malice prepense*, for I do not, and I feel sure that in the past our nurserymen did not realise in the least the mischief which they were doing.

The third principle of the Act is to provide against the further introduction of insect pests and plant troubles into the Colony, and provides further powers in this connection than formerly possessed.

THE BURRWEED ACT.

In connection with the administration of this statute, it is only fair to say that very little headway has been made. Burrweeds were as plentiful as formerly and scarcely any more activity being displayed in their removal. To a very great extent this is due to the faulty construction of the Act, which in general application is quite unworkable.

During the season 1904-5, wherever Burrweeds were reported by Locust Officers, notices were served upon the occupiers of the infested lands, and I gather that in most cases the weeds were removed. No prosecutions were made at the instance of this office.

The provisions of this Act and its amendments extend to the three following plants:—

The Burrweed (*Xanthium spinosum*).
The Ditch Burr (*Xanthium strumarium*).
The Thistle (*Cnicus diacantha*).

I should like to make my position quite clear upon the question of this weed legislation, the administration of which fell into my hands rather through inadvertence than design.

The first arrangement was that it should be administered by the Director of Agriculture, and that District Locust Officers should act as Inspectors, their reports being collected by this Division and forwarded to the Director of Agriculture. Upon the reorganisation of the Depart-

ment, which took place in 1904, the matter was placed definitely in my hands.

I at once realised the impossibility of putting into practical effect the law as it stood. Whilst never imagining that any weed ever has been or could be exterminated by Act of Parliament, I believed that the moral effect of such legislation was good, acting as a stimulant towards keeping weeds under control. Further, as a matter of observation, I had noticed several other weeds, of a worse nature than those mentioned, spreading in the Colony. Upon these grounds:—1. The laws for the suppression of weeds which appear on the statutes of so many countries; 2. That their moral effect is for good; 3. That worse weeds were obtaining a foothold in the Colony; and 4. That the law was ineffective, I recommended to the consideration of the Government the amendment of the law, and submitted a draft Bill to meet, as I thought, the requirements of local circumstances. A Bill based upon my draft was submitted to Parliament and thrown out. The principles of that Bill were unimpeachable, and, as far as its provisions extended to other weeds than the three upon the black list, it was bound, from a legislative point of view, to act beneficially.

The position, which results from the dismissal of the amending Bill, is that the old Burrweed law with all its faults remains in operation.

With regard to the three plants enumerated, I should like, with all due deference to plant specialists, to place upon record my opinion of them as weeds *under Natal conditions.*

The Burrweed (*Xanthium spinosum*) is notorious all the world over as a weed. Its unenviable reputation is based solely upon the fact that when common in sheep-rearing districts the burrs, becoming entangled in the wool, seriously depreciates the commercial value of that commodity.

Now, so far as my observations go, this weed only flourishes in Natal upon broken lands. Thus it is found growing near road-sides, along railways, in old kafir kraal sites. It does not readily grow in the grass veld, nor is it ever established there. As most, if not all, of our sheep country is grass veld the weed obviously is never a great nuisance, nor have I heard of complaints regarding it from sheep-farmers. Furthermore, if the plant grows upon sheep farms on the sites I have enumerated, it appears to me that the sheep farmers would and should attend to its suppression in their own interests. Should they chose to neglect it, it can scarcely be regarded as anybody else's duty. The only argument that the sheep farmer can make in favour of the Burrweed Act is that it is to keep the weed from spreading again on to his lands after he has suppressed it thereupon.

I feel sure that however well the Act may be amended, the eradication of the plant is economically and practically an impossibility.

The Act came into existence in 1874, when there was a general outcry about the effect of the weed in other countries. Since then, nothing that has been done has had any practical effect, and the weed is now in as bad and aggressive a form as it ever will be, and that I

regard as a negligable quantity. In other words, it is not a serious pest and never will be.

The Ditch Burr (*Xanthium strumarium*) is an aggressive plant which abounds on the coast lands and midlands, and is found growing in similar positions to the common Burrweed; it, however, prefers moister situations. It has no virtues, but, regarded as a weed, it is not nearly so pernicious as many others which abound throughout the Colony. It appears to me that had the weed been known by some other technical name than *Xanthium*, it would not have been legislated against. The only complaint I have of it, is that the Burrs become entangled in the tails of horses and oxen, but I doubt if the inconvenience caused thereby is one-thousandth of that caused by the notorious "black-jack."

With regard to *Cnicus diacantha*, it is quite true that one or two of those weeds, erroneously described as "Scotch Thistles," are occasionally met with in Natal. At the same time I have never observed an authentic example of *Cnicus diacantha*. This group of thistles are weeds, of course, but I cannot contend that they are worthy of the distinction of special legislation; indeed, they are not nearly so bad as the Mexican poppy, a weed which abounds in certain parts of the Colony, and which has even been mistaken by Scotsmen for their floral emblem.

PORT EXAMINATIONS.

Proclamation No. 405, 1905.

The examination of fresh fruit and vegetables, fruit trees, plants, etc., is conducted by Mr. C. B. Jones, Surveyor of Customs, as examiner. Monthly returns have been regularly published in the *Journal* of the Department; a precis of these returns is appended.

It is interesting to note that there is but little falling off in any particular line. Although these items are, in a sense, very small, they indicate sufficiently that many things are not being produced in the Colony which very well might be. The importation of seed potatoes shows a slight increase over the year 1903, and the importation of table potatoes is, curiously enough, but little more than half. Other lines are much in advance of 1901.

Apples, 15,163 cases.
Apricots, 684 cases.
Peaches, 144 cases.
Lemons, 3,891 cases.
Onions, 8,899 cases.
Ornamental Plants, 133 consignments.
Fruit Trees, 312 consignments.
Seed Potatoes, 34,480 cases.
Pears, 204 cases.
Plums, 404 cases.
Oranges, 2,631 cases.
Grapes, 4,821 cases.
Garlic, 140 cases.
Bulbs, 26 consignments.
Grape Vines, 6 consignments.
Table Potatoes, 30,354 cases.

ASSISTANTS.

I wish to take this opportunity of expressing my appreciation of the services of Messrs. Berensberg and Kelly, which have been loyally

ndered throughout the year. During my absence Mr. Kelly attended all matters relating to correspondence and Mr. Berensberg to insect vestigations and the study of life histories, etc.

The services of both these officers have rendered somewhat possible e many and complex duties falling to this office.

Both gentlemen have from time to time acted as inspecting officers, id have attended agricultural shows in charge of exhibits illustrating e natural economy of insects.

Mr. Berensberg has been instrumental in considerably augmenting e working collection of insects, in diagnosing specimens, and preparing r exhibition life histories of the more important insect pests.

COTTON DISEASES, ETC.

Attention has been given to your instructions with regard to the re-ıbilitation of the cotton-growing industry and, whenever reported, me investigation has been made of any suspicious circumstance arising connection with pests and blights.

In April last the presence of the so-called "Cotton Fly" was re-ɔrted at New Guelderland. This insect is said to have destroyed the tton crops in years gone by. Mr. Berensberg was despatched to the strict, but he failed to find insects doing any damage. His attention as drawn to a small creature as the pest, and he was ultimately success-l in securing about half-a-dozen specimens in the whole field.

These proved to be a small homopterous insect, commonly known ; a frog or leaf-hopper, and closely related to the well-known "spittle-ıg" of peach trees.

It is a very small species, 1-10th inch in length, 1-50th inch in idth, of a general green colour, with transparent wings. The im-ature specimens resemble the adults in colour, but are without wings. 'he creatures are very active and difficult to capture, hopping and flying way with great alertness when approached.

These insects were subsequently noticed in greater abundance upon Ir. Thompson's cotton plants at Umzinto. Here they were sometimes ı masses upon the leaves. They did not appear, however, to be doing ny material damage.

One of the most insidious pests of cotton—the Boll Worm—abounds ı Natal, but no remarkable damage has yet been reported to me as rising from its attack. It was noticed upon cotton leaves in Umzinto. 'ecommendations for the control of this pest, by planting trap-crops of ıealies, were made early in the pages of the *Journal*, and at least one entleman, Mr. John Kirkman, followed this excellent course.

In connection with this insect, I think it well to state that it will robably prove more troublesome on the higher lands than upon the ast. It is certainly more abundant from Botha's Hill upwards than ı the littoral. I cannot say at present whether this fact is attribut-ıle to climatic conditions or to the better system of dealing with the

mealie crop adopted upon the coast by Europeans and Indians alike than is found higher up country.

SUGGESTED LEGISLATION.

I wish to place the following minute on record:—

ENTOMOLOGIST TO MINISTER OF AGRICULTURE (18TH AUGUST, 1904).

For your consideration:—

1. The advisability of legislation to destroy and prevent the further spread of the English sparrow within the Colony.

2. The desirability of amending the "Small Birds Protection Act" so as to make parents, guardians and heads of kraals liable for the wanton outrages of small people, black and white, upon these creatures, and to provide penalties for the possession of and use of catapults.

3. The desirability of legislation designed in order to prevent the introduction of vertebrate and invertebrate vermin into the Colony. Suggested clauses:

1. After the promulgation of this Act, no Society, authority or person shall introduce or import into this Colony or turn at large or liberate for the purposes of acclimitization or sport, or as game, any living animals, bird or reptile, other than such recognised as farm stock and domestic animals, without the consent, in writing, of the Minister of Agriculture.

2. Any Society, authority or person who offends against or fails to comply with the foregoing, is liable to a penalty on conviction of not less than £5 sterling and not exceeding £50 sterling.

CLAUDE FULLER,
Government Entomologist.

18th August, 1904.

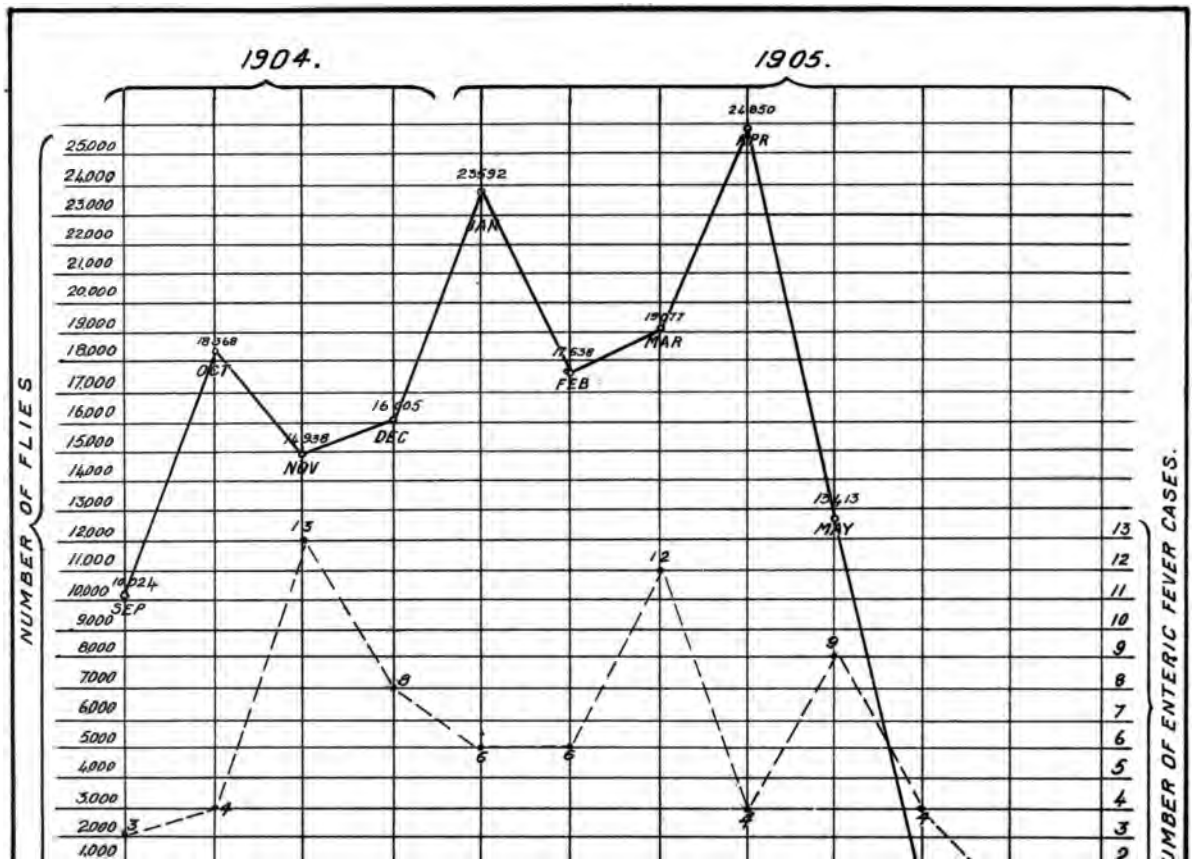
HOUSE FLIES.

In connection with investigations into the prevalence and abundance of house flies in Maritzburg, the accompanying chart, prepared from collections made every day in one place, is submitted as a matter of interest. Owing to the lateness in submitting this report the chart covers 12 months.

STATEMENT OF EXPENDITURE.

This statement shows the funds as voted by Parliament which are administered under my supervision, and subjoined thereto is a rough statement showing the disbursal thereof.

CHART SHOWING PREVALENCE OF FLIES FROM SEPT. 1904 TO MAY 1905
AND OF ENTERIC FEVER CASES IN PIETERMARITZBURG.



APPROPRIATION AND SUPPLEMENTARY SUPPLY, 1904-5.

VOTE XXXVI., GOVERNMENT ENTOMOLOGIST.

	£	s.	d.
A. Entomologist:—			
1. Salaries	939	0	0
2. Incidental and Miscellaneous Expenses	228	0	0
B. Locust Destruction:—			
1. Salary	450	0	0
2. Temporary Locust Officers, Transport, and Materials	4,800	0	0
C. Fumigation of Plants	50	0	0
D. Plant Diseases and Burrweed Acts	500	0	0
	£6,967	0	0

STATEMENT.

		£	s.	d.
A. 1.	Entomologist	625	0	0
	Technical Assistant	200	0	0
	Clerical Assistant	84	0	0
	Port Examiner	30	0	0
A. 2.	Travelling Expenses, Entomologist and Staff (4)	65	9	7
	Rail Fares and Freight	52	8	6
	Printing	15	8	0
	Purchase of Carbon Bisulphide	22	11	1
	Illustrations for *Journal*	20	14	1
	Books, Publications, Accessories, and Expenses in connection with Investigations	105	14	6
	Native Messenger and Cleaner, with Clothing and Rations	28	0	0
B. 1.	Chief Locust Officer	450	0	0
B. 2.	Temporary Locust Officers (42) and 2-300 Natives	3,345	0	0
	Railage, Transport, and Incidental Expenses connected with Locust Destruction, Purchase of Materials	1,518	0	0
C.	Purchase of Cyanide and Tents for Fumigation of Plant Imports and Sale to Farmers	44	8	11
D.	Expended in connection with Plant Diseases and Burrweed Act	12	14	10
	Expedition to Brazil	126	0	0
		£6,745	8	6

REPORT OF THE CHIEF LOCUST OFFICER.

MINISTER OF AGRICULTURE,—

I submit herewith a resume of the 1904-05 Locust Campaign, which has been prepared at my request by the Chief Locust Officer.

I would draw your attention to the successful use of Arsenite of Soda, and the saving in trouble and expense effected by the use thereof, owing to its ready solubility in cold water.

CLAUDE FULLER,
Government Entomologist.

22nd May, 1905.

LOCUST SEASON, 1904-5.

GOVERNMENT ENTOMOLOGIST,—

With the end of the month of April came the cessation of the locust destruction work for the season 1904-5. The following is a short resume of the work done pending a full report to be submitted at the close of the financial year.

The season just passed compares very favourably with that of 1903-4 with respect to the areas infested and the presence of the "hoppers," or young locusts.

As pointed out in my previous report, practically the whole of Natal and Zululand were infested by the pest in January and February, 1904, necessitating the employment of 87 District Locust Officers and the expenditure of close on £8,000.

During the season just past 42 District Locust Officers were employed, working on an average of 75 days each. Over 30,000 swarms were destroyed, as against 55,000 swarms last season (1903-04). The cost of the campaign amounted in round figures to £4,750, or practically half the cost of the preceding year.

In Zululand the hoppers were very numerous, and in many cases the hatchings and their subsequent venue were in the fever districts. This country is not only extremely difficult to traverse, but very unhealthy, and where practical operations are impossible. There were 15 District Locust Officers appointed for Zululand alone, and, had the funds under the control of the Department permitted, several additional officers could beneficially have been appointed to work in that area.

The amount originally voted for locust destruction work figured in the Estimates for the current year at £2,300, but, on representations being made by the Government Entomologist to the Minister of Agriculture, executive authority was obtained for an excess of £2,500, making a total of £4,800 for the year.

Many and various were the demands made upon the Department, and, had these all been conceded, the amount voted would have been

ite inadequate, and a heavy excess would have resulted. Instructions d been received that the expenditure was not to exceed the amount anted, and great care had to be exercised in making concessions to e various infested areas. Requests from public bodies and private dividuals were received asking for assistance, which, so far as was nsistent with the general work, were granted.

The northern territories of Natal, especially the Vryheid, Paul-tersburg and Babanango districts, were heavily infested, and neces-ated the organising of a staff to combat the pest. This being the first ar that this portion of the country came under the administration of e Government as far as the locust work was concerned, it was deemed pedient to send up a practical man to demonstrate to the farmers the ethod of destruction which had proved so satisfactory in seasons past. s soon as the farming community had grasped the methods exemplified Locust Officer Erfmann, and, after meetings had been convened and dressed by that officer, appreciation of the measures advocated was parent throughout the infested areas, and expressions of thanks made the Government for the assistance rendered. Now that practical sults have been experienced by the farmers in these northern terri-ries, co-operation may confidently be looked for, as the method em-yed to destroy the hoppers gave the greatest satisfaction, and, com-g, as it does, well within the scope of every farmer, fully justifies the pectation that the work in future will be carried out by those most nefiting by the results.

The coast districts, as was anticipated, were again the favourite tching grounds of the locusts. This season, however, compared some-nat favourably with the last as regards the number of swarms. On the rthern coast belt particularly the season was a comparatively light e, especially from the country between the Umhloti and Tugela Rivers. ne south coast belt, however, was thickly infested, and there being two stinct hatchings made the work the heavier, necessitating the same ound being cleared twice.

The Natives are beginning to appreciate the value of the work done, d have evinced far more readiness to assist the officers in charge. ere still, however, remains a tendency on their part to look to the overnment to protect their crops, with as little exertion on their part possible, and examples had to be made in some instances where Natives fused to give the required assistance.

The question again arises as to the reporting both of the laying of e eggs and the hatching of the locusts. If this most important in-rmation was rendered faithfully to the Department by the public, the ork would be greatly facilitated, and it would be more effective and eaper. Some parties have urged that the locust officers should be pointed before hatching commences, in order to supply these reports, t if this were done it would entail an extra outlay of about £1,000, nich seems scarcely justifiable.

There is no doubt that this reporting is discouraged amongst the tive population, and I regret to say that their "white brothers" are ore than lax in this respect, unless indications point to their own vac-ular crops being in jeopardy.

A good deal of intimidation goes on amongst the Natives with respect to reporting, one or two cases coming to notice during the season just passed. The law provides a penalty for not reporting both the laying of eggs and the hatching of locusts, as well as for not destroying the hoppers, and it is the intention during the coming season to see that the law is complied with, both by the white and black population.

It has been stated by some that locusts reaching the adult or flying stage, after going north, return to the scene of their youth, and they in turn lay eggs in or about the same locality. This possibility is not to be denied, but upon the whole the locusts which lay their eggs in the summer come from the north. One portion of country in the south of the Colony has been positively cleared of young locusts, and not a single swarm came to the adult stage. If during the coming season hoppers again appear in this district, it may safely be accepted that they have come from some remote part of the country, or, what is equally possible, from countries north of Natal and Zululand.

The use of the arsenic solution with its beneficial effects and its harmlessness to cattle, etc., is too well known to need any further eulogy. The herbage sprayed by the solution undoubtedly dies off, but in a few weeks it has recovered and surpassed its original verdure.

The Government Entomologist purchased five tons of Arsenite of Soda in the commencement of the year, and, although this did not arrive in time to use at the commencement of the campaign, later on use was made of some of the mixture with good results. The value of the arsenite lies in the fact that, containing as it does the arsenic and soda, it saves in transport, and dissolving in cold water renders boiling unnecessary.

In a telegram dated 23rd January, 1905 (A & M 263/05), we received an application from the Government Entomologist of the Transvaal asking if arsenic, sugar and spray pumps could be lent by this Department or purchased on behalf of the Transvaal Government for use in locust destruction. The negotiations led to the sale of two tons of arsenite to the Transvaal Department of Agriculture for the purpose indicated. From statements made by the Transvaal Entomologist in his "Notes on Locust Destruction" appearing in the *Transvaal Agricultural Journal* for April last, the use of this chemical must have given satisfaction, as it is stated that a supply of ten tons is to be secured for next season's work. It is gratifying to note that the methods adopted so successfully in our own country are slowly but surely being called into requisition by our neighbours.

This brings forward the question of an organised plan of campaign by all States south of the Zambesi, a matter which Natal has put before the Colonies for the past five or six years. It is to be hoped that in the near future, with the successful adoption of Natal methods by the Transvaal and Orange River Colony, this question will receive more sympathetic consideration than has hitherto been given to it.

Whilst it is impossible to look forward to the entire suppression of a pest common to the whole of the vast continent of Africa and flourishing in practically inaccessible regions, the fact remains that the annual

destruction of swarms by systematic methods represents increased prosperity to the State and to the individual.

For our own work we have never put forward any extravagant claims. In point of fact it is impossible to estimate with any certainty the exact gain. That there can be no loss is evidenced by individual cases. To quote some of these we may instance the case of a farmer whose lands were overrun with hoppers which had emerged from eggs deposited thereon. These hoppers were attacked with locust poison and the estate cleared at an outlay in chemicals and labour of under £5. Had the hoppers not been killed they would have undoubtedly destroyed the crops, which included a field of mealies which subsequently realised £500.

In the case of a large sugar planter, we have been given to understand that, prior to the initiation of systematic work under the Locust Act, his outlay in destroying locusts used to amount to nearly £1,000 annually, and despite this a large amount of cane was destroyed by the succession of locust swarms coming from the country adjacent to his plantations. Since then we are assured that his outlay in ridding the fields, which are, of course, of great extent, has fallen to about £200, an expenditure which saves all the crop.

To those of us who know the indifference of the native to destroying locusts and to saving his crops from their onslaughts, the problematical saving to the State appears very great indeed, for there is no question that again and again have local famines been brought about through the destruction of Native gardens by locusts, and in not a few of these instances large amounts were expended in feeding the Natives and supplying them with seed mealies the next season.

W. H. BUSHBY,
C.L.O.

20th May, 1905.

Sixth Report of the Government Entomologist.

Office of the Government Entomologist,
December, 1906.

LETTER OF TRANSMITTAL.

To the Honourable the Minister of Agriculture,—

Sir,—I have the honour to transmit herewith a report upon the work of my office for the year ended 30th June, 1906.

CLAUDE FULLER,
Government Entomologist.

EXPENDITURE.

Upon the whole vote for services under the heading "Government Entomologist" a saving was effected. A considerable saving was effected upon the amount voted for locust destruction, which was due in a very large measure to the lightness of the invasion, particularly in Natal proper, and, to a certain extent, to more economical working.

Of the amount allocated for Burr-weed destruction but very little was expended. With this saving I was much in sympathy because, as indicated in my last report, I do not consider that there is sufficient justification for the expenditure of large sums of money by the Administration in any attempt to eradicate Burr-weeds, more particularly so whilst the statutory powers granted are so limited in their scope.

NURSERY INSPECTION.

The inspection of Natal Nurseries has been one of the main features of the work of my Branch during the year, and a considerable amount of time has been taken up in this manner. Every endeavour has been made upon my part to have our nurserymen get their premises free of the various fruit tree pests which in the past have been liberally disseminated throughout the Colony from such centres. In some cases as many as half-a-dozen inspections have been made of some premises. In my last report I expressed satisfaction with the progress which our nurserymen

had made in cleaning up and reorganising their premises, but further progress has not been all that one was justified in expecting. At the same time the nurseries of Natal are now in a condition which compares favourably with those of the other Colonies of South Africa. From possessing the very worst reputation as distributors of insect pests to their present position is a very creditable advance.

There are several incentives to the nurseryman to keep his nursery in good order and free from pests. One is that as an honourable business man he should sell to his customer good articles in return for good coin; another because, by law, any customer may return plants which are suffering from disease; and the third is to obtain a permit to export his produce to the neighbouring Colonies.

Nursery pests are not many, and there is no reason why nurseries should not be free from them. Among deciduous fruits there are practically none of importance. Apples are liable to "woolly aphis," but with the use of the Northern Spy stock and the removal of old infested trees from the vicinity of the nursery, the pest is a negligible quantity. Peaches and plums are liable to "aphis" attack whilst in the nursery; but, with winter spraying, and fumigation before delivery, no nurseryman need send this insidious pest gratis to any of his customers, and so aid in its further distribution throughout the Colony.

Citrus nurseries are the greatest trouble to get into clean order, and the plants are much subject to the attacks of five pests. In the order of their importance, these are: 1, Red Scale; 2, Mussel Scale; 3, Circular Black Scale; 4, Soft Scale; and 5, Citrus Psylla.

I attribute the difficulties encountered by nurserymen in freeing their stock from the more pernicious of these, viz., "Red Scale, Mussel Scale, and Circular Black Scale," first and foremost to the original condition of the nursery; and, secondly, to the proximity of permanent and infested trees.

In the propagation of nursery stock nurserymen would be well advised to always plant their blocks of citrus at some distance from orchard blocks of similar trees, and to forego the fad of growing their type trees from which to propagate in the nursery. If this innovation does not recommend itself, then these permanent trees should be planted so that the deciduous are in proximity to the citrus stock, and citrus to the deciduous stock.

For the control of citrus insects, particularly the least harmful but none the less disfiguring psylla, constant spraying seems necessary, particularly under the existing environments of most of our local nurseries. In spraying, that method which shows the greatest effect at the least expense is doubtless the most economical. This is a question which the nurseryman must solve for himself. There can be no question of the general efficiency of paraffin emulsion when thoroughly applied; and, provided that there are no infested permanent trees in close proximity, and no badly infested plants in the nursery, even the worst of the pests *enumerated*—the "Red Scale"—can be successfully controlled. In applying the spray the question of cost has to be considered. With small

blocks of trees and cheap Indian or Native labour, one nurseryman, who has been signally successful in controlling these citrus pests, finds that the small hand vaporizers, of which several patterns are on the market, costing from 2s. 6d. to 7s. 6d. each, are the best. The work is slow, but the saving in material, and the effectiveness with which it is applied, more than counterbalance the loss in time. In spraying, then, nurserymen have to choose between the use of the vaporizers or hand sprayers and a knapsack pump fitted with a fine Cyclone (or Vermorel) nozzle.

Several nurserymen have done a considerable amount of fumigation, treating the plants in the rows, but have been discouraged by the expense and the meagre result attained. In these instances, however, it has been a case of attempting the impossible, because scale insects had already obtained such a strong hold of the plants that speedy and absolute eradication was impracticable. It is not for me to make any attempt at teaching any nurseryman his business; but the sooner the practice of discarding old stock becomes universal, and the sooner the purchasing of "big" trees by earnest but misguided amateurs is discouraged generally by nurserymen, the better it will be for the purchasing public and for the trade.

PORT EXAMINATIONS.

The examination of fresh fruit, fruit trees, plants, etc., coming within the Regulations, is still conducted under the supervision of the Surveyor of Customs. Monthly returns of the various consignments passing under inspection have been published throughout the year in the *Agricultural Journal*. As a precis of these returns is usually published annually in my report, I propose to discontinue their publication in the *Journal* in future.

Without in any way wishing to disparage the work done by the Surveyor of Customs in assisting this office in the inspection of fruit and fruit trees coming into the Colony from abroad, I wish to emphasize the desirability of having an Entomologist at the Port to act as examining officer. The Board of Advice appointed under the Plant Diseases Act submitted a resolution to the effect that this work should be conducted by a qualified man. This view, I hope, will be adopted. To take a case in point, Natal is threatened with the introduction of the Codling Moth. This is the most insidious pest of the apple, and any increase of expenditure in the maintenance of a qualified officer at the Port would be justified upon this ground alone, in view of the growing interest in fruit culture in Natal and on account of the many thousands of apple and pear trees which have been planted out by farmers during the last three years. The fruit trees to arrive from Australia alone for planting in Natal this spring already total 8,668, despite the restriction of fruit importations to 100 trees, in all, by one party.

Further than this, representations have several times been made to me that worm-infested apples have found their way on to the Durban market. Of this I have no actual proof, but the matter is so important a one that I have arranged for the inspection of all apples by an officer of this Department, who has to proceed to Durban for the purpose, an inconvenient and expensive arrangement.

IMPORTS.

	Cases.
Seed potatoes	59,000
Table potatoes	9,747
Onions	15,625
Apples	12,311
Lemons	4,470
Oranges	993
Grapes	4,951
Plums	78
Pears	84
Water Melons	1
Artichokes	10
Ornamental Plants	199
Grape Vines	1
	Consignments.
Fruit Trees	179

Under Regulations, the importation of oranges and lemons from beyond South Africa was prohibited; but, in view of the representations made by importers and the fact that the other Colonies were not in favour of this restriction, this regulation was not brought into force.

PUBLICATIONS AND CORRESPONDENCE.

The following publications have appeared in the *Agricultural Journal*:—

Title.	Form.	Issue.	Volume	Pages.	Author.
Pineapples for Export	Note.	July.	VIII.	644-7	C. Fuller
Orchard Fumigation	Article.	,,	,,	697-715	,,
Grape Troubles in Natal	,,	Aug.	,,	787-97	,,
Potato Moth	An open letter	Sept.	,,	873-876	,,
The Fruiting of the Male Paw Paw	Note.	Dec.	,,	1,214-7	,,
Some Criticisms of a Prize list	,,	Feb.	IX.	97-100	,,
Sorehead or Chicken Pox	,,	March.	,,	204-6	,,
Thuja Hedge Aphis	,,	,,	...	207-8	,,
The Fruit Fly	,,	,,	...	232-4	,,
Slugs and Snails	Article.	May.	...	443-50	,,
Locust Invasions	Note.	,,		462-6	,,
Butterfly Collection	Article.	,,	...	474-80	H. van P. Berensberg.
Do.	,,	June.	...	594-9	

During the 12 months, there were in all 1,883 communications sent out from this office and 1,820 received. These figures do not include official minutes or circular letters.

1905-6 RECORDS.

In order to indicate the nature and extent of the work done in this branch, as apart from general administrative duties, the inspection of nurseries, the letters and visits of advice to farmers, judging at agricultural shows and lecturing, I beg to submit a few notes upon some of the observations made.

A few subjects have been selected, and I cannot help expressing my ret that the complexity of the subjects falling to me, and the erratic nner in which questions from time to time arise, entirely prevent me m giving, to many matters of great biologic interest which pass conually before me, that attention which they merit.

During the summer our plague locust, so well known as *Acridium puriferum*, or the Red-wing locust, was successfully carried through all stages from egg to adult in breeding cages in the office. To do this on the top floor of a four-storied building in the heart of the City will obably be news to many entomologists. An interesting result of this dertaking was the short period in which the locusts after hatching om the egg came to maturity in comparison with the time taken in the ld. The shortening of this period is due to the fact that in the open e insects do not feed so continuously as when confined. The falling nperature makes them sluggish in the field, and again whenever it ns they feed but little. The insects under observation were successlly reared by feeding them on fresh sugarcane leaves daily. It is rhaps interesting to note also that during the experiment there was a ght outbreak of locust fungus disease, which was controlled by removg the sick individuals. It supplied an instance, however, of how genery widespread are the spores of the locust fungus which, under prolious circumstances, will destroy such large numbers of this pest.

Apart from the biologic interest attaching to the experiment, it had very practical bearing upon the conduct of the field operations.

Eggs.—The eggs were laid between the 19th and 27th of November, 06. They commenced hatching upon the 29th of December, the last ung locust emerging upon the 5th of January, giving an incubation riod of from 30 to 40 days. As a matter of fact, eggs laid in the field Darnall upon the 28th of November hatched upon the 28th of Decemr, or in just 30 days.

In hatching from the egg it was noticed that the slit or crack through ich the young locust emerged was enlarged by the forcing of the body ices into the back of the head. The juices appear to pulsate, but ter the creature has emerged the swelling of the head remains a perinent feature of the insect. Most writers upon this subject state that e insect moults its skin immediately after leaving the egg. Our obervations went to show that the moulting was simultaneous with the tching of the larva. After the young locust has emerged this eggoult is seen attached to the tip of its abdomen, and drops off with the st hop that the young animal takes. Apropos of this flicking off of the g-moult, there is a belief amongst some of our Coast farmers that, hilst the female locusts die after laying their eggs, some of the male usts live until the young emerge and act as nurses to them. Indeed, e planter assures me that the males shepherd the young locusts, herdg them on to suitable food plants. That a few locusts always remain out until the eggs hatch is generally well known, and the natives tell that these old locusts wait until the young "have wiped the tears om their eyes," a poetical reference to the white egg-moults.

When nine days old the insects again moulted their skins, being then

about ½ an inch long. As cane-planters have noticed that when about to moult the locusts often leave the canefields for the grass headlands, they should be upon the look out for this occurrence about nine days after they hatch.

About ten days later moulting again occurred, the insects then being about 7-10ths of an inch in length. Seven days later another moult occurred, and seven days after that another, when the wing pads became visible upon the backs of the locusts. This stage lasted for nearly three weeks, when the locusts became mature or winged insects.

Another unsuccessful attempt was made to bring the Mylabrid beetle grub, which feeds upon the locust eggs, to maturity, but without success; and a further original observation is to be reported in the appearance, for the first time, of a wasp parasite of the egg.

COTTON LEAF ROLLER.

During a visit to Mr. John Kirkman's cotton plantations my attention was drawn to the attack of a moth caterpillar upon the foliage of the cotton plants. The attack was not altogether general, and was the more common adjacent to the natural bush—only separated from the cotton plants by a few feet.

The caterpillars were a glassy green and transparent, and were secreted away in a funnel formed by a portion of the cotton leaf. These funnels—like the paper funnels in which one purchased sweets as a child—were uniformly constructed; the insect first making a cut in the leaf commencing from near the stalk, and then across the radiating ribs in a semi-circular cut, so that the outer corner of the margin of the leaf could be conveniently rolled in. The leaf was held in its rolled position by strands of silk, placed regularly and like stitches. The funnel and its method of construction forcibly reminded one of that made by the small beetle so cleverly described by Dr. Sharp in "Insects," of the Cam. Nat. Hist. series.

The caterpillars fed upon the leaf as rolled up, and it seemed that when circumstances demanded it, *i.e.*, with the eating away of the inrolled surfaces, more of the leaf was rolled up. In most cases a leaf accommodated two caterpillars, one on each side of the mid-rib. Very often the caterpillars will also feed upon adjacent leaves, attaching them for convenience to the mouth of their funnels with silk.

POTATO CATERPILLARS AND BEETLES.

In view of the many leaf-eating beetles and caterpillars of the potato recorded from other parts of the world, one cannot help being struck with the almost complete absence of such in Natal. I say almost complete, because the potato moth does occasionally destroy the foliage—mining in it—and in that large area of the Colony known as Klip River County a leaf-eating ladybird is sometimes met with. Upon the whole the complaints of insects with this particular proclivity reach this office from across the Border. In Harrismith district the beetle seems *prevalent* and destructive, and I learn from that well-known Natalian.

Mr. Bruce Hutchinson, that caterpillar plagues are not uncommon on potato crops in the Standerton district of the Transvaal. Mr. Hutchinson's account of this pest very fully agreed with one described as occurring at the Hawkesbury Agricultural College, New South Wales; and I communicated to Mr. Hutchinson the account given by Mr. W. W. Froggart, Entomologist of New South Wales, of the method there adopted in dealing with the pest. Recently, in conversation with Mr. Hutchinson, I learned that he had again been troubled with the caterpillars, and had adopted the New South Wales plan with satisfactory results. This was the use of a very simple form of hopper dozer, constructed from a sheet of 6-foot iron and a piece of wood. In shape it resembles an Irish curragh. The wood is shaped and used as the stern piece, and the iron cut in front and overlapped so as to form a prow. This is drawn through the potato field and the caterpillars jarred of by two men beating the vines on either side into the boat, and retained there by the coating of wet tar with which it is previously lined. An upright partition along the middle of the craft renders the capture of the caterpillars more certain.

A STINGING (?) BEETLE (*Atractocerus brevicornis, Linn.*)

This curious beetle, characterised by its very short wing cases and wasp-like wings, has been sent to me as a creature capable of inflicting a dreadful sting. Whether this is true or not I cannot say, but the powerful ovipositor of the female looks very formidable, and the loud buzz which the creature makes when on the wing is, in itself, sufficient to inspire respect, and to account for this belief.

THE FIG BORER (*Phryneta spinator*).

Quite a number of complaints are made each season relative to damage done to fig trees by the large white boring grub, which is the larva of a conspicuous longicorn beetle. As a rule the attack is not general, and only a tree here and there is affected. In other words, the beetles seem to prefer trees already suffering from their injuries in which to deposit their eggs. The attack is usually made low down upon the stems arising from the ground, and is indicated by the sawdust thrown out of the burrows made by the insects. If neglected, the attack becomes more serious and general. Owners of fig trees should always be upon the alert and watch their trees for the attack of this borer. In many cases it may be destroyed in its burrow by squirting paraffin or carbon Bisulphide into the holes through which the sawdust is being cast out, or the grub may be killed by probing with a pointed wire. If these methods fail, the infested part may be removed and destroyed, together with its occupant.

THE MAGGOT FLY AND THE ISI-BUNGU.

The isi-bungu or floor maggot of Natal and Zululand is by no means uncommon, I understand upon good authority, but, as a rule, it is only found in the huts of careless old women. Incidentally, the term "isi-bungu" is also applied to the maggot found in the flesh. Since the abnormal abundance of flesh maggots in 1901, there has been no recurrence of the trouble, and it would now seem that I was probably mistaken in regarding the floor maggot as identical with that causing myasis.

If this is so, then we have three kinds of these flies in Natal. That from man has been identified as *Auchmeromyia* (*Bengallia*) *depressa*; the floor maggot is probably the same as that of the Congo, *A. lutcola*; and that of dogs, found usually beneath the skin of the legs, is, from authentic specimens which I now possess, certainly a very distinct species.

TWIG WILTERS.

Every spring a series of complaints reach this office of the damage done to growing plants by these large plant-eating bugs. Quite a number of different kinds are involved, but all are much alike, of dull brown colour, large size, and usually possessing abnormally formed hind legs. In attacking plants, these creatures usually insert their proboscis or pumping mouth into the young shoots, a few inches below the apex. This causes the twig to wilt almost at once, and it rapidly dies. The insects are not uncommon in flower gardens and are usually most partial to dahlias. As a rule, they make their appearance in October and November, and go on breeding throughout the summer, hybernating as adults through the winter. The nuisance is mostly a spring one, because the eggs of the first brood are less parasitized than those laid later on. There seems no better plan of meeting the attacks than that of hand-picking as many as possible, and destroying all egg clusters noticed. For insects, the eggs of these creatures are large and conspicuous, larger than ordinary sized beads, and can be easily recognised because they are deposited along twigs and branches like a string of beads, being placed end to end so that the cluster is sometimes three or four inches long. Regularly visiting the garden and destroying the creatures will check their mischief a great deal, as a single bug, in the course of its development, is capable of wilting a great number of twigs, besides bringing forth many young ones. As they are usually active during the heat of the day, and the adults fly readily if approached closely, it is best to collect them early in the morning, whilst they are a little torpid—like the worm who falls an easy prey to the early bird.

A MOTH-CATCHING PLANT.

This vine is well known throughout the Colony; *Physianthus albens* is, I believe, its botanical name. Owing to frequent references in foreign exchanges as to its remarkable nature, enquiries are often made as to the desirability of introducing it into the Colony. Of course there is no necessity to do so, and the plant, like most easily applied measures against insect pests, has no real value in this connection. That it does catch insects—bees and moths—all who possess a vine are well aware, but very seldom is anything of importance captured. At the same time, it is only right to point out that quite often specimens of the moth whose caterpillar is so destructive to the beards of mealies in Klip River District, and which is notorious as the Boll-worm of cotton, are found caught in this plant. As an adjunct to mealie fields where this pest is troublesome, and to cotton fields, this plant then might prove useful. It is very doubtful, however, whether the number of moths which it captures would make any material difference.

The trapping of insects by the flower of this plant is purely accidental. The plant has no use for the dead insects, and does not "wish"

to catch them. The accident is due to the physical weakness of the insect. Like many another plant, it relies entirely upon the agency of insects for pollenization. The pollen sacks being securely packed away and hidden in the flower where they cannot escape, they require to be extracted forcibly. By a special contrivance of the plant, the insect is captured, so that in its struggles to liberate itself it will expend the force necessary to draw out the pollen sacks. If the insect is unable to do this it is trapped and dies.

THE BROWN SCALE (*Lecanium oleae*).

This world-known scale blight of citrus trees has only once been brought under my notice in Natal. During December last Mr. C. Emmett sent to me a piece of orange twig to which were attached several specimens. In replying to Mr. C. Emmett's enquiries, I wrote: "It has never proved itself a dangerous or injurious species in South Africa, because of the presence of a natural enemy, a small parasitic wasp. Your specimens are of great interest, and I would be glad if you could arrange to send me further specimens." Mr. Emmett reported that it soon disappeared from his trees.

POULTRY TROUBLES.

The poultry troubles which are usually referred to this office are three: Chicken Lice, Scaly Leg, and Sore Head. Occasional enquiries have also been made about fleas and fowl ticks. Though several cases of gross infestation of houses and runs by the last mentioned have been met with, the pest is by no means so common or prevalent as one might expect. Of the other four troubles one may unhesitatingly say that they are primarily due to neglect and its natural accompaniment of filth and dirt.

CHICKEN LICE.

The most common species I take to be the common Hen Louse (*Menopon pallidum Nitzch*). "Remedies for this species must aim to reaching the hiding places of the lice on the roosts and in the cracks of the walls of the hen-house, as well as to destroy those on the fowl. Thorough fumigation and whitewashing, with careful attention to cleanliness, will do much to keep them in check. Pyrethrum, paraffin, etc., may be used direct upon the fowls, and if they are liberally supplied with ashes and road-dust they will do much to protect themselves." (H. Osborn.)

SCALY LEG.

This disease is due to a parasitic mite (*Sarcoptes mutans*), and is quite well known. The scales of the legs and feet are raised and separated, and a white chalk-like matter forms between them. Under the crusts and scales the mites live and breed. Diseased birds should be isolated. The treatment consists of softening the scales by standing the legs in tepid water, and removing gently with a brush or the finger nail so as not to cause bleeding. When dried, Helmerich's pomade is applied, and this must be washed off after a couple of days. One application usually affects a cure. Balsam of Peru is regarded as a certain cure. A mixture of equal parts of vaseline and flowers of sulphur rubbed into the limb is also said to cure this complaint.

Helmerich's pomade is prepared from two parts sublimed sulphur, one part potassium carbonate and 8 parts of lard.

CHICKEN FLEAS.

These pests differ from ordinary fleas in that they stick like a tick. As a general rule they are found in abundance about the eyes, often in such numbers as to form a thickly set ring. Unlike the Jigger Flea, they do not penetrate into the flesh. Whilst the inconvenience and irritation might be expected to be excessive, I have not noticed that the eyes becomes closed or greatly inconvenienced. The fleas are very firmly attached, and a pair of forceps is usually necessary to remove them. The best treatment is to carefully brush the fleas with a camel hair or sable pencil, moistened with paraffin. Free fleas, probably males, are to be observed crawling about the fixed ones, and in the neighbourhood of the affected region.

This species is supposed to be *Sarcopsylla gallinacea* Westw., originally described from Ceylon.

BACON FLY.

Under date of 29th September, 1905, a farmer correspondent sent me, labelled "pests that trouble us and interest you," specimens of a small fly "which are proving themselves agents of destruction to hams and bacons by laying their eggs in the lean parts, the eggs hatching into maggots. The first time I noticed these flies was about two years ago on an imported ham I had occasion to buy at one of the local stores. Can you tell me if it is a native of this country?"

The flies were recognised as *Piophila cerasi*, the adult form of the notorious "cheese jumper," and was no doubt a very early introduction into Natal. Their favourite foods are cheese, bacon and ham, these articles of diet becoming infested with maggots through the flies laying their eggs thereupon. Even to me, a lover of insects, cheese maggots have always been peculiarly repulsive, and I must confess that I cannot appreciate how the presence of small animals and their excreta can enhance the edible qualities of an article of diet. In the case of attack upon bacon and ham, this insect is capable of becoming a serious pest, and farmers who cure their own supplies should always try and eliminate them. They are always likely to be introduced to the farm-house with cheeses and hams from stores where business in these lines is slow. Badly infested stuff should be got rid of and the rest cleansed. Hanging bacons and hams should be covered with cloth to prevent the flies laying their eggs upon them.

SPIDERS DAMAGING ORANGE TREES.

A peculiar case was brought under notice where the unthrifty condition of some orange trees was attributed to the residence therein of a number of spiders whose nests and webs made a great mess of the trees. This invasion of citrus trees by spiders is by no means uncommon, and, owing to the accumulation of dirt and debris in the webs, the trees not only become unsightly, but the exclusion of light and air tends towards their decadence and the increase of scale-insects. It must be recognised,

However, that this effect is of quite a secondary nature, because before the trees have become a suitable habitat for the spiders they have already reached a stage of unkemptness and unthriftiness through neglect which is inexcusable. In short, the spiders are only incidental to the trouble, and are blamed because they are the more easily seen. In all such cases a good cleaning out of dead and weak inside growths (which never properly develop) and a little manuring will be the best treatment for such trees.

MEALIE SMUT.

This disease is often common, and several correspondents have written asking whether it would be a wise plan to treat the seed before planting in the same manner as oats are treated. From the investigations which have been made into the natural history of this parasitic fungus, it is without doubt very different in nature to the smuts of oat, wheat, and barley, and the means suggested of minimising the trouble by some treatment of the seed are useless in contending with mealie smut.

The reason why such methods are not worth adopting in the case of diseased mealies lies in the fact that the natural history of the fungus causing Mealie Smut is quite different from that of those causing smut in oats, barley and wheat. In these cases it appears from very reliable investigations that the parasite only gains an entrance into the young plant within a short time of the sprouting of the seed, and hence the efficiency of a treatment which will destroy any spores of oat, barley and wheat smut clinging to the grain of such plants. The parasite causing mealie smut can secure an entrance into the plant at any time whilst growth is actively proceeding.

Probably one of the most potent factors in spreading and maintaining mealie smut is the use of kraal manure. Kraal manure plays a two-fold part in this connection. In the first place it is, when moist, a medium in which the spores of the disease germinate readily; and, further, fresh dung from animals which have eaten smut carries the disease into the field. "The digestive processes do not destroy all the spores, nor is the length of time required for their destruction in rotting manure definitely known."

It will be seen that where a field becomes infested with smut the disease is likely to become worse and worse every year. The smutted cobs and plants are naturally left upon the field, and the cattle grazing in the mealie stalks naturally feed upon such; indeed, experiments justify one in saying that they prefer them. This helps to distribute the disease further over the field in the animals' droppings, and then when the field is ploughed over in the spring, and manured with dung, almost every condition suitable to the development of the disease is provided.

Rotation of crops furnishes a practical control of the trouble, but this cannot always be indulged in by mealie-growers. Again, kraal manure is too valuable and necessary to be wasted, and must go on to the mealie lands.

When, then, there is the slightest indication of the trouble being

upon the increase, the farmer has no course open to him to control it excepting by using old well-rotted compost, and collecting and burning all smut masses before they mature and scatter their spores. This course will eliminate the possibility of lands becoming seriously invaded with smut, and there should be no great difficulty attached to it if the farmer makes a point of removing such at each cultivation and at harvesting, or trains his native servants to do so.

MOULDY AND SMUTTED MEALIES AS FOOD FOR STOCK.

A good deal of suspicion has fallen upon both mouldy and smutted mealies as articles of diet for farm animals both abroad and in Natal. Investigations into the effect thereof have so far proved more or less negative, but the suspicion has never been completely removed. Amongst other ailments attributed to diseased mealies is abortion in cows. The following summary of results by American investigators may be of interest.

"In the following tests recorded by the Michigan Station corn smut in varying quantities was fed to three grade Shorthorn cows and one grade Jersey cow, in addition to a ration of corn, wheat bran, ground oats and linseed meal. The cows were in different stages of lactation (the milking period). Two of the cows were fed with as large quantities of smut as they could be induced to eat, the amount being increased from two ounces at the start to eleven pounds per day. The test lasted forty-nine days. No signs of abortion appeared in the pregnant cows. The milk yield in the case of the cows giving milk was regular and constant, and no indication was given of any variation in this respect from normal conditions.

"The conclusion was drawn from this experiment that when cows are gradually brought into the habit of consuming large quantities of smut it does not appear injurious to them. What the result would be if cows unaccustomed to it gained access to large quantities must be left for future experiment. It is probably safe to say, however, that the quantity of smut that would be likely to exist in a field or on the stalks, fed under normal conditions to cows, would not be dangerous to the health of the animals."

In the United States the spread of cerebro-spinal meningitis was popularly believed to be due to eating mouldy mealies. More especially as in 1898-99 a wet fall was responsible for a large lot of mouldy mealies and the disease was epidemic. "The Indiana Experiment Station studied the epidemic and its relation to its alleged cause. An examination of a large number of specimens of mouldy mealies from different localities showed that one bacterium and two moulds were common to all samples.

"Tests of the poisonous properties of the mouldy corn were made with two horses. After a preliminary feeding period, 5 c.c. (about one-sixth of an ounce) of an active bouillon of the bacterium found in mouldy corn was injected under the skin. After an interval of six hours this was followed by on injection of 10 c.c. No appreciable effect was observed, not even so much as an abscess occurred. Five days later a

similar test was made with a culture of one of the moulds isolated from the spoiled mealies, and, after a like interval, a similar test with a culture of the other mould. In neither case was any abnormal symptom observed.

"Each of the three micro-organisms was then grown in mealie meal previously sterilised. In various ways the horses were induced to eat as much as 5lbs. per head daily of the infected meal, each micro-organism being tested for a period of five days. The effect of the meal inoculated with the bacterium and one of the moulds was negative. The meal inoculated with the other mould—a fusarium—produced redness of the gums and some salivation.

"The horses were then fed on all the spoiled mealies that they would eat. On the first three days they ate it readily, and after that it was with difficulty that they could be induced to eat any.

"In none of the tests was cerebro-spinal meningitis induced by the mouldy grain." The deductions drawn by the station from the investigations follow:

"The results of the experiment show that inoculation with cultures of the bacterium and moulds were ineffective. Eating of the mashing containing pure cultures showed that only in the case of a growth of a species of fusarium did any intestinal disturbance follow, and that in one case the feeding of the rotted grain produced considerable intestinal disturbance and some nervous symptoms, but that the disturbance was light in the other.

"It appears, therefore, that, while many of the cases of sickness in stock attributed to eating mouldy corn are due to other causes, the continued use of such food may result in intestinal and nervous disorders of a serious nature."

NATAL

Department of Agricult

SEVENTH REPORT

OF THE

Government Entomologi

1909-10.

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SEVENTH REPORT.

REVIEW OF THE YEAR 1909-10.

THE first six months of the year under review were fully occupied in connection with the Departmental export of citrus fruits. The final shipment of the 1909 season was made on 26th August, and it was not until the end of the year that all accounts and other matters pertaining thereto were finally adjusted.

During the past five months an effort has been made to recover some of the ground lost owing to the years 1908 and 1909 being almost wholly devoted to matters relating to fruit export, and some enquiry has been made into the present status of the insect pests and other troubles of wattles.

Experimental citrus export upon an extensive scale has now been undertaken over three seasons, 1907, 1908, and 1909. Throughout, the Government has been the moving spirit, supplying the funds to enable the first and conducting the second and third. Financially the first and third seasons' shipments can only be described as bitterly disappointing; the second series of shipments were of moderate dimensions, local conditions were favourable and the market was receptive, hence it was successful. So much has already been written and said upon the matter that it is not intended to overburden this report with any further discussions, but rather to place on record those conclusions which I have arrived at regarding this important subject.

I would premise by saying that the actual loss to fruit-growers has been largely magnified and frequently enlarged upon for specious reasons. Those fruit-growers who have lost have not lost more than the actual fruit, and when one comes to consider the losses of pioneers in fruit export in other countries, growers here have rather to congratulate themselves than otherwise.

Where considerable loss has taken place it has occurred through ill-advised and often rash speculation, and to this feature much of the loss to growers can also be attributed.

The experiment has been a costly one to the Government, but when the results are dispassionately reviewed it will be found that they are such as to justify the experiment and its cost.

It has to be borne in mind that citrus growing in Natal had become quite extensive, with a minimum of trouble, of culture and expense, the

industry paid and one after another was encouraged to embark upon it. But as time went on not only did other supplies destroy the almost complete enjoyment of the monopoly of a good market, but that market also became depressed. Indeed, it may be said with some justification that citrus culture upon the coast at any rate had reached a crisis. Thus it became imperative to seek some other outlet for the crop. There was every reason to believe that our naartjes would prove acceptable upon the European markets, and it was decided to test them upon a fairly large scale.

As the upshot of three extensive trials, it can be at least said that today we know fairly exactly where we are in regard to citrus culture and citrus export, and are in possession of facts which might otherwise have taken many years to establish, and then, perchance, not altogether satisfactorily. If in no other direction, this Division has at least established a record as regards packing, and with its demonstrations and the standard set up, the Natal citrus grower has no excuse for putting badly packed fruit upon any market.

The results of the experiments may be generalised as follows:—

I.—NAARTJE EXPORT.

The hopes so long entertained of building up a large export of naartjes give no promise of speedy realisation, and it is questionable whether at any time the trade in this fruit will reach anything like the dimensions of fruit export lines of other countries.

It can be said with much justification that, for some time to come, the prospects of export do not warrant any extension of the area under this fruit. In fact, with proper management, the existing naartje orchards will meet export requirements and local consumption for some years to come.

So far as really profitable prices for fancy and selected naartjes are concerned, the London market is limited to what can only be regarded from the export point of view as a very small affair. The unfortunate feature, from a local point of view, is that the summer fruit season in London coincides with the time of arrival there of the bulk of our crop. The heavy expenses involved in placing the naartje satisfactorily upon a so distant market, expenses which are not likely to diminish for some time, require that the fruit fetches fancy prices to make shipment worth the while.

What can be said with assurance is that shipments of one to three thousand trays per week, timed to arrive before and up to the advent of strawberries and cherries, will prove very profitable. Subsequently, when naartjes are most abundant and cheapest here, shippers must be very circumspect in sending any quantity forward least the fall in prices, bound to come about, swallows up in expenses even their earlier profits.

II.—COAST ORANGES.

The export of coast-grown oranges is proved too hazardous. This fruit is exceptionally delicate and will not stand the strain laid upon it. Taken as a whole, coast oranges, whilst of exceptional flavour, are, furthermore, not up to export standard. Our experience in this connection is by no means exceptional, and in other countries where citrus are grown under similar climatic conditions the same weakness has been observed. By attention and manuring both size and colour can be improved, and it is equally probable that their carrying qualities may be enhanced.

III.—LEMONS.

The oversea export of lemons was sufficiently demonstrated unprofitable. However, in the culture of lemons for South African markets there is room for extension, but in this pursuit up-to-date methods in handling and curing are absolutely essential. Common rough lemons should be generally abandoned, and have no place in any commercial orchard.

IV.—MIDLANDS ORANGES.

The export of up-country oranges, speaking more particularly of those grown in the Richmond, Maritzburg and Greytown belt and further inland, has been attended with very satisfactory success, and orange culture in these regions will stand extension for export purposes, particularly as regards Navel oranges.

These oranges even under the many disadvantages of last season carried with promising success, and the prices obtained justify the continuance of their export.

CENTRAL PACKING HOUSE.

The chief feature of the Departmental export was the establishment of a central packing house in Durban, where citrus fruit from all parts of the country was sized, graded and packed. The establishment of this institution as a temporary measure was fully justified by the circumstances of 1908, but the packing of fruit for export in one centre was never seriously entertained, nor was its continuance through a second season deemed advisable. However, the experience gained in 1908, when every circumstance tended to make this experiment a success, seemed to show that this method was to some extent feasible, but under the strain and conditions of the 1909 export it broke down altogether.

It may safely be stated that such an institution could never be made self-supporting under existing conditions—conditions which are not likely to change—and further that the system, entailing as it does so many handlings of the fruit, is one that has very properly been abandoned. Central packing houses upon a co-operative basis in the midst of districts devoted to orange culture may become desirable in time, but anything of the sort for naartjes cannot be recommended.

CITRUS ROT FUNGI.

In connection with citrus export and bulking very largely as drawbacks to its success are the fungi generally known as "Blue Moulds."

Until recently it has been generally believed that the decay in transit of citrus fruits was due to the action of a fungus known as the Blue Mould of citrus fruits (*Penincillium digitatum*). The recent mycological investigations of Mr. Pole Evans have, however, thrown much light upon the matter by the discovery of a further form of decay which he has described as *Diplodia natalensis* or Black Rot. In our 1908 export we were certainly not troubled by this disease, and as a consequence the extraordinary amount of wastage occurring in the 1909 shipments were inexplicable, upon the assumption that *P. digitatum* was the destroying agent.

Although both of these moulds are dependent upon some surface injury to the rind to gain access to the fruit, the latter fungus may not show superficially until 10 to 15 days after the fruit has been affected. Further, fruit is subject to natural infection after it has been plucked even so long as ten days.

It was not until the packing season was well advanced that it was clear to me that either some further organism was to blame for the wastage reported or else the common mould had developed an abnormal character.

Those who visited the packing house during the latter part of the season are aware of the extraordinary precautions that were taken to eliminate the mischief by inspecting all fruit three or four days after packing and re-packing before lidding. By this system the wastage in transit was reduced immediately and almost eliminated.

During Mr. Evans' visit to Natal I gave it as my opinion that, in the case of naartjes, I felt convinced that the fungus often gained an entrance through the cut surface of the stalk. In the case of *P. digitatum*, it is safely assumed that this fungus only gains its entrance through rind abrasions, and practical experience bears this out. Whether or not it can be demonstrated that the *Diplodia* can only gain its entrance through a rind abrasion, the fact remains that in the majority of cases throughout my experience every appearance indicated that the fungus had entered through the cut stalk.

In any case, however, this Black Rot is of a far more dangerous nature than Blue Mould, and calls for very particular attention.

From the information I have been able to collect, the trouble is of long standing, but its attack and prevalence is subject to seasonable influence. There is every reason to believe that the late rains of 1909 had considerable bearing upon its ascendency. It is generally conceded that these late rains do affect the keeping qualities—or rather the carrying

qualities—of naartjes, making them more tender, but apart from this they also distribute the spores of the fungus more generally, spattering them up from the soil with dirt into the trees.

That Black Rot is more prevalent in some orchards than in others there is little doubt, and, so far as I can ascertain, it is practically confined to the coast.

If for no other reason the prevalence of this disease calls for the abandonment of centralised packing upon the coast.

PINEAPPLE EXPORT.

Apart from the first series of experiments early in 1909, which has already been fully reported upon, a second series of shipments was made with a view to clearing up some of the points at issue.

The following particulars refer to a series of three shipments of pineapples packed and sent forward by me to London. These shipments were by the R.M.S. "Carisbrook Castle," 18th February, R.S.M. "Armadale Castle," 24th February, and the R.M.S. "Norman," 4th March; the fruit was sold upon the 13th, the 20th to 22nd and the 27th to 29th March, respectively, the sales being effected through Mr. T. J. Poupart, of Covent Garden, and Messrs. Mitchell, Cotts & Co.

The terms of shipment were the same as those extended in December last, the Government paying for freight, boxwood and packing and handing the London proceeds over to the growers who supplied fruit. The experiments met with scarcely any sympathy or support from the growers.

Boxes and Packing.

It will be remembered that in the first experimental shipment a scratch box was used which held a dozen one-and-a-half-pound pines, packed in two tiers or layers. This double-layer packing was so condemned over the cables that I supplied myself with single-layer cases for these shipments, manufactured locally, some being of imported white wood sawn in Durban and the others of wattle wood and made up by the Harden Heights Wattle Company. In view of the full analysis I was able to make of the results of the first shipment, it is now a pity that in these later shipments a further trial of 2-layer parcels in cool chamber was not made; if, for no other reason than to confirm the result arrived at that pines in two-layer parcels carried satisfactorily in the cool chamber.

For the small pines I used a box measuring 22 x 25 x 5 inches over all, and for the large Cayenne pines a partitioned box measuring 40 x 20 x 7 inches over all.

Made up the small white wood boxes cost 1s. 4½d. each and the wattle wood 10½d. each, delivered at the Point. The large white wood cost 1s. 10d. each and the large wattle wood 1s. 4d. each delivered. The

wattle wood boxes I found to be quite equal to the white wood for pines, but let me say at once that unless the wattle wood boxes can be made and delivered at half the price they were, growers will have to fall back upon imported boxwood for exporting pineapples, for the simple reason that box boards of the best quality with printed ends can be landed in Durban duty paid at 4 3-10d. per set in the smaller size, and, of course, can be carried some distance by rail and put together at under 6d. each. I have not a quotation for the large boxes, but, upon figures before me, I am justified in putting imported boxes in at 9d. each.

The pines were wrapped in what is known as butter-paper, or in common paper bags, and fine, best quality wood-wool was used as packing. I have already indicated that shredded mealie husks make an excellent packing for pines, and as wood-wool costs up to £12 imported direct and £20 per ton purchased from local agents, it will be seen that a vast saving can be effected by using what is at present a waste product in Natal. Further than this, mealie husks are used for the Azores pines and the fine wood-wool has proved injurious right through our experiments. Moreover, I gather from a report before me that in a series of shipping experiments conducted in Hawaii the shredded mealie husk has proved the better packing. It will be noted from the Commercial Agent's reports that wrapping the fruit is considered to be unnecessary, but he advises wrapping the crowns. As a packer of pines I would prefer to always wrap them.

The "Carisbrook" Shipment.

The "Carisbrook" shipment comprised 20 boxes of small pines (18 of 12 fruits and 2 of 14 fruits), 18 large boxes of Cayennes (1 of 6, 8 of 8, 2 of 10, 5 of 12, 1 of 14, and 1 of 16 fruits), also 1 large box containing 6 small Cayennes and 7 Queens), all in cool chamber.

It is necessary to point out here that this shipment was made before Mr. Harrison's report upon the preliminary shipment had come to hand, and, whilst I had already determined upon not shipping any green pines by cool chamber, some pines about three-parts coloured were shipped. Having the opportunity in the meanwhile of of analysing the above-mentioned report, in the two latter shipments no off-colour pines were included.

There are two other features of the shipment which have to be dealt with in order that the result may be clear. One gentleman who, I understand, has been shipping large Cayennes with a fair amount of regularity to London, asked me to send some of his fruit in the same condition as he himself was shipping, with a view to ascertaining whether better prices would be realised upon Covent Garden market than he was realising by placing the pines elsewhere.

Another gentlemen was anxious for me to thoroughly test a preserva-

tive dressing, and in three shipments sent forward there were a number of pines sent which he treated himself.

It is, therefore, necessary for me to present an analysis of this report under several sub-headings.

Comparative Trial.

Fifty-eight Cayennes: 3 boxes of 8, 2 of 12, 1 of 10 fruits each. These fruits when sent to me were for the most part far more backward in colour than any others packed, and with a view to saving freight they were packed much more tightly than is the practice of the shipper upon whose behalf the comparative test was made. Of these fruits 5 arrived too green, 6 green, 16 greenish, 3 fairly ripe, 14 ripe, 3 fully ripe; 6 bruised, 2 specked. It is, therefore, seen that the pines arrived practically as packed, ripening up somewhat before coming under the influence of the cool temperature. Half the bruising occurred in one of the 8 packs, and I do not think it was due to too tight packing. In one case of 12 pines, which was tightly packed, the 3 pines suffered, and the crowns bent in packing would not straighten afterwards. Ten of these pines were "greenish," and that the crowns would not straighten is very probably due to this fact. With regard to the tighter packing, I may say that I was able to effect a saving of 50 per cent. in freight thereby.

The following table shows the state when packed and condition on arrival of the fruit.

Mark.	No. of fruits	Condition on arrival.	By Sales. a/c.
			s. d.
D 1.	8	2 ripe, 6 greenish	8 0
D 2.	8	5 too green, 3 fairly ripe ...	8 0
D 3.	8	3 bruised 2 green, rest ripe ...	8 0
D 4.	10	7 sound, 2 specked, 1 green ..	12 6
D 5.	12	10 greenish, 2 ripe	9 0
D 6.	12	2 over-ripe, 3 green, 3 ripe, 4 bleeding	9 0

Commenting upon these pines the Commercial Agent says: "Pines will not sell upon this market in a green state."

Preservative Test.

In this shipment I overlooked informing the Commercial Agent that certain pines had been submitted to a preservative treatment, so that his report thereupon is quite impartial.

The treated pines were Cayennes, 1 case of 16 and 1 of 14 pines; these were ripe and well-coloured when shipped. They realised 6s. and 7s. per case respectively, or 4½d. and 6d. each. The following comments are made by the Commercial Agent:—

"Sixteen case, pines fully ripe and reddish colour. Nearly all specked and some mouldy; one or two showing green patches. Some of

the crowns double the size of pine; rather too big. Somewhat too ripe on being packed. Fourteen case, majority with mildew on outside, only 6 first-class fruits." It will be found from the reports upon the later tests with this preservative that treated pines always became mildewed upon the outside, and invariably arrived in a worse condition than the untreated pines.

Small Cayennes.

Three cases of small Cayennes weighing just about 2 lb. each and fully ripe when packed were well received, realising 8s. per dozen, despite the fact that four were rotten, and nine "specked." From the Commercial Agent's comments, I gather that this is an acceptable fruit, and there is no doubt they were shipped too ripe. The price realised should be quite profitable, as Cayennes of this grade cost no more to forward than "Queens."

Cayennes Three-Parts Coloured.

This lot of pines were on the whole only three-parts coloured; some, however, were fully ripe. They were sent forward to me very carelessly packed, and some so crushed that I had to reject them altogether. In all they numbered 38, 6 being 5 to 5½ lbs. and 32, 4 to 4½ lbs. in weight. Four of the 5 lb. pines realised 1s. 6d. each and 2, 1s. each. Of the 4 lb. lot 8 fetched 1s. 3d. each, and the balance 1s. each.

Winkel Spruit Experiment Farm Cayennes.

No instructions regarding picking and packing were issued to the Manager of the Experimental Farm, and throughout the experiments these Government pines have been treated by me as from an ordinary grower. The pines were received in a fairly well-coloured condition, which had been acquired upon the plants. Report:—

No. 1 case. 8, 4 to 4½ lbs. pines: "Arrived; 6 good, 1 bruised, 1 fully ripe. Had a warm, even colour which makes a fine fruit, realised 1s. 4d. each.

No. 2 case. 10, 3½ lbs. pines: "Although a little green, a very good case. No fruits bruised, realised 1s. 6d. each."

No. 3 case. 6, 2 to 2¼ æs. pines: "Very fine, even coloured, sound, realised 7s. per dozen."

One other lot of 4 to 4½ lbs. pines which arrived in good order realised 1s. 6d. each, but the majority of the pines only fetched 1s.

Altogether 147 Cayennes were forwarded for sale, including those already commented upon under "Special features," but only 100 were in a fit condition for sale, and these fetched 1s. to 1s. 6d. each, according to size and condition. Upon condition alone the Winkel Spruit pines realised 1s. 4d. against 1s. for pines of equal size but less carefully handled.

SMALL NATALS.

The prices realised for small Natals proved more satisfactory upon the whole. As will be seen upon reference to mark x in the subjoined table, the Experimental Farm pines again scored.

Mark.	No. of Fruits.	Weight.	Condition when Packed.	Commercial Agent's Report.	Prices.
					s. d.
X1	12	1¾	Sound and bright NOTE.—Pines at 1¾ are over that, but under 2lbs. Pines at 1½ nearly 1¾. Pines at 1¼ nearly 1½.	Bright crowns; best fruit of any. All evenly coloured and bright	7 0
2	12	1¾	...	Perfect condition, bright; good crowns	7 0
3	12	1¾	...	Bright, excellent crowns; all good; splendid condition	7 0
4	...	1½	...	Very attractive; crowns all bright and good fruits	6 0
5–8	12	1½	..	Excellent; perfect condition, good crowns; all realised 6s. per dozen	6 0
9—10	12	1¼	...	Excellent: perfect condition; good crowns; both realised 5s. per dozen	5 0
GG A1	12	1¾	Nicely coloured	A clean looking Pine, very nicely coloured indeed; sound	6 0
2	12	1¾	,, ,,	Very pretty colour; one or two bruized; nice sized fruit (see special features 3)	6 0
G1	16	1¼	Scratch case	Dirty looking lot, although of fairly good colour; crowns crushed; fully ripe	5 4
G2	16	1¼	Coloured	One rotten; excellent case otherwise	5 4
G3	16	1¼	,,	Good case; one reddish colour	6 8
G4	18	1	,,	Good case and even eyes, also colouring; good crowns	6 0
5	18	1	,,	Good case; crowns, fruit and colour nice and bright	4 0
H H	18	1	Coloured up	(See special features 3)	5 6
G D	10	½lb	Bright Baby Pines	,, ,, 4, 60 fruits at 2½ each	13 0

"ARMADALE" SHIPMENT.

The "Armadale" shipment comprised 40 boxes and six trays of small Natal pines and 16 boxes of Cayennes.

Special Features

1. MARITZBURG CAYENNES.—These pines were received at the Point upon the 17th of February, but were so backward in colour that I decided to keep them over to see if they would colour up sufficiently. This proceedure was not altogether very satisfactory as some of the fruit had been picked in too backward a state to colour well. The best were selected

and forwarded on the 24th, that is about a week after they were gathered. These pines are remarkable for their comparatively small crowns, and are popularly spoken of as "King pines," although only a variation of the ordinary Cayenne. They seem to possess a marked tendency to leak their juices. This is, of course, a feature of all our large Cayennes, but it is more pronounced so far as my experience goes in this type. There were three cases of 10 fruits each sent, two of which realised 10s., and the other 4s. 6d. the case, the pines weighing about 4½ lbs. each.

The following are the reports upon the three cases:—

No. 1. Rather small crown, though satisfactory. Eight good condition, fully ripe. Majority evenly colcured, except two, showing a little green. Two leaking, but fair consistency.

No. 2. Eyes rather green, all fairly even, warm colour, two slightly bleeding, and one bleeding badly at stalk.

No. 3. Very good colour, two greenish towards crown, three sweating.

2. PRESERVATIVE TESTS.—

(A) One case. Pines treated and packed on 20th February and shipped on 25th. This case was sent to the Commercial Agent with the following statement:—

"These fruits will have been fully ripe for seven days before being placed in the cool chamber. I would like you to report fully upon their condition on arrival, and if they are sound will you please keep several of them by you with a view to ascertaining how long they will keep after coming out of the cool chamber."

Report.—"One absolutely rotten. All the crowns yellowish and ragged. Fruits showing mildew on the outside. Opened one at once, dead ripe but sound inside, very juicy, flavour delicious. All the fruits of deep red somewhat over-ripe colour of a sodden appearance, also dark-looking in patches."

(B) One case. Four pines treated, four untreated. Pines fully coloured and fresh when packed. Maritzburg type.

Report:—

Untreated: "Deep eyes, small crowns, good, looked quite ripe, even colour."

Treated: "Good crowns, deep eyes, good stalks, not so evenly coloured. One bruised and bleeding, another bleeding slightly, two good condition, but all quite ripe enough. Will report further." The treatment seems to have made no practical difference.

(C) Two cases, 10 each.

Report:—1st case. "Fruit and original colour good, but greasy looking. Crowns very nice, and size well liked. The preservative cannot be too strongly condemned. It destroys the appearance, the mildew

having to be wiped off, and seeing this no person would be inclined to buy, however good and sound the fruit is inside."

2nd Case. "Four of the pines compare in evenness and colour to the Azores, and if of a less sodden appearance (? preservative) would have been just as attractive. This preservative is fatal to the appearance on opening up. If the pines can be guaranteed to land here in this condition (without preservative) there is not much doubt that they will eventually compete not only on fair terms, but on better, with the Azores, by reason of superior flavour of the Natal-grown pine."

In a number of other cases of treated fruit the treatment calls no comment, except two, in one of which 10 out of 16 were unsaleable, and in the other 9 out of 14.

3. A COMPARISON. Two packages of small Natals ripened to a golden yellow on plants gathered on the 19th, packed on the 20th, and placed in cool chamber on the 25th for comparison with one case of pines picked in the green-black stage and allowed to colour up. These pines took six to seven days to colour sufficiently and acquired a fairly good colour, but the eyes were pointed and the bracts of the eyes somewhat withered.

Report:—"The pines allowed to colour upon the plants and packed and held back five days on opening up proved: No. 1 case. Very pretty in colour. One or two bruised. A nice sized fruit (about 1¼ lbs.). This or a little bigger (2 lbs.) is the size that should be arrived at for a large regular trade. No. 2 case. Clean looking pines, very nice colour indeed. Sound."

The pines coloured from green-black stage are reported upon as follows:—"Very pointed eyes. Sound condition, but somewhat dirty looking. Colour dull undecided yellowish red. Crowns fairly good. No comparison with above." The former pines railised 6s. per dozen, the latter (only 1¼ lb. in weight) fetched 3s. 8d. per dozen, but cost 25 per cent. less to place upon the market.

4. *Baby Pines.*—Four fruit boxes holding 26 fruits each and six 3 inch trays holding 10 fruits each of ridiculously small pines of a nice bright colour but not weighing more than half-a-pound each were sent with a view to ascertaining whether these ratoon pines would realise a sufficiently profitable price if shipped in trays, it being thought that they might sell to costers and flower girls. Those sent in the cases were very tightly packed and suffered considerably on this account. Those sent in trays were unwrapped and without packing and arrived generally sound, and are reported upon as pretty looking pines, a fact due to better ventilation and absence of jamming in packing. Upon those in trays Mr. Poupart reports that he could sell them in small quantities at about 3d. each, but would not recommend very large quantities. This, of course,

would be very profitable, but there is nothing to be gained in supplying a particularly limited market.

SMALL NATAL PINES.

The following tabular statement will convey the best idea of the results of shipping. Mark x are pines grown at Winkel Spruit Experimental Station. The prices realised, except in six cases, were quite unprofitable, and, in comparison with those of the former and later shipments, equally inexplicable:—

Mark.	No. of Fruits.	Weights.	Condition when Packed.	Commercial Agent's Report.	Prices.
					s. d.
X 1	12	1½	Coloured uniformly	Very good; two slightly specked	3 0
2	12	1½	,, ,,	Mostly sound and evenly coloured; attractive crowns on big side, could, with advantage, be smaller	6 0
3	12	1½	,, ,,	,, ,,	3 0
4	12	1¾	,, ,,	Eight excellent pines, four specked	3 0
5	6	2	,, ,,	All excellent, except one specked	3 6
GG 1	12	1½	Uniformly well coloured when picked	Nine good, three specked; appearance very fair	3 10
GG 2	12	1½	,, ,,	Majority good; several gone or specked; all fully ripe, and of very fine appearance.	3 10
GG 3	12	1½	,, ,,	,, ,,	3 10
G 1	14	1¼	Specially coloured	Good condition and colour, except two	3 0
2	14	1¼	,, ,,	Eight good, one specked, and five unsaleable; even colour and bright	3 0
3	12	1½	,, ,,	Two specked, condition and colour good	3 0
4	12	1½	,, ,,	Three specked, two rotten, seven good	3 0
5	12	1½	,, ,,	One bad; rest in excellent condition; crowns a very nice size	6 0
6	12	1½	,, ,,	Six good, four specked, two rotten	3 0
7	12	1½	,, ,,	Six specked; all good even colour; pretty good crowns	3 0
H 1	12	1½	Coloured	Nine good one rotten, two specked	6 0
2	14	1¼	,,	Four specked, ten good	5 0
H 3	12	1½	Yellowish	Good as to crowns and colour; a little greenish	6 5
H 4	12	1¾	,,	Excellent condition; all good	10 0
D 1	12	1½	Coloured	One specked, one greenish; good crowns and appearance	4 6
2	12	1½	,,	A fairly good case, a few specked. of nice bright appearance	4 6

"Norman" Shipment.

The "Norman" shipment was made up of 76 cases of pineapples.

Amongst these one package of 12 pines was forwarded to Dresden r private report. The pines were all about two pounds each in weight d well coloured. They were sent by cool chamber and arrived at their stination about a week from London. The pines had gone off some- ıat, but were in fairly good condition and valued at three to five illings each.

The following are the special features of this shipment:—

1. Three cases containing 28 Cayenne pines, which had been picked ı the green side and allowed to colour up for six days after packing, ere sent by cool chamber for comparison with two cases containing 16 nilar fruits from the same plantation which had been allowed to colour ɔon the plants.

The result of this experiment was all in favour of the pines which ter packing had coloured up before being placed in the cool chamber. hey had coloured more evenly than those on the plants for one thing, and ıriously enough the crowns were greener and fresher than those of the tter.

2. Seven small cases containing 18 and 20 fruits which were slightly ried when packed were shipped by cool chamber with a view to ascer- ıining whether it was practicable or desirable to "cure" ripe pines a ttle before shipment. The report states that all the fruit arrived sound ıd of bright colour.

3. Twenty-one cases of 12 each of small Natals grown at Winkel pruit and running about 1¾ lb. each were sent in cool chamber slightly nder colour—that is well but not highly coloured and were regarded as ne and all round samples as it was possible to get.

These are reported upon as follows:—

"An attractive, clean pine though a dull colour. Arrived upon the hole in splendid condition and fresh. The crowns excellent. A pine ıat sells well but should be a little bigger, say, 2 to 2½ lbs." These cases veraged 5s. each, eight realising 4s. 4d. each, eight 4s. 6d., four 6s., and ne 7s. *Note*: For cool chamber shipment these pines could have been eld back a week.

4. Quoting from my covering letter to the Commercial Agent:— In the ventilated hold there are 15 cases of small pines and one of ayennes. A number of the "Small Natals" approach the Cape pine in ıeir small size and smallness of crown. If my local experiments go for nything these latter packed quite green should arrive well coloured, but erhaps a little on the withered side. The large box of green Cayenne ines I do not expect to carry, and will not be surprised to hear they are uite bad on arrival."

The following is extracted from Mr. Harrison's report:—

"The box of Cayennes ex ventilated hold was thrown away. There were black patches all over the fruit and the crowns were ragged and shrivelled. Although the pines were firm to the touch they were black at the core in almost every case. The small pines by ventilated hold arrived in splendid condition and of a bright reddish colour. The crowns were in general good and only a little discoloured at the tips." This fruit realised an average price of 4s. 6d. a case. Twelve boxes of 12 fetched 4s. 6d. each, one of 18 fruits 6s., and one of 24 fruits 5s., one case fetching 2s., the fruit therein being discoloured.

The following statements give general particulars as to the condition of fruit when packed and upon arrival. The packing material was in all cases wood-wool:—

i. CAYENNE PINES IN COOL CHAMBER.

Mark.	No. of Fruits.	Weights.	Condition when Shipped.	Commercial Agent's Report.
		lbs.		
D	8	5½	Coloured up for six days after packing; in good condition, and carefully packed	Fully ripe; several bruised; good crowns; fairly deep and even colour
D	10	5	,, ,,	Beautiful colour on upper side; one rotten; others mostly specked or bruized
D	10	5	,, ,,	Colour good, but better on one side than other; fully ripe; one bleeding badly
G D	8	5½	Coloured up on plants packed and shipped at once; all in good condition	Good class of fruit, but uneven in colour; crowns a little yellowish; nearly all bruized; one bleeding badly; one rotten
G D	8	5½	,, ,,	Even coloured; fresh appearance, but not so brightly coloured as D; a number over ripe
G	8	5	...	Lot G.—Most of this lot of Cayennes had been carelessly handled, and badly forwarded to the packing house. The fruit was ripened upon the plants, and was not uniformly coloured
				Four cases; condition not good; treated with secret preservative
				Out of the 24 fruits only two arrived sound. The remainder arrived bruized, bleeding and musty
G	8	5½	Eight fruits from lot G; four treated with preservative; four untreated	The four untreated pines of good colour on one side. They were firm but sweating a little. The other four all specked and mildewed.

G	8	5½	Specially selected from Lot G, but not treated with preservative	A good case; firm fruit and dry; the best condition on the whole, aud most attractive of those sent
G	10	5	Six cases. Typical of Lot G	At least 50 % unsaleable except as specks; many bruized and over ripe
G	12	4	Six cases. Typical of Lot G	A bad lot on opening up
G	14	3	One case of Lot G	Five in fair condition; three mildewed; crowns crushed
G Y	8	5½	Three cases of ripe and well coloured pines; over ripe when packed; not treated with preservative	This fruit all arrived in an unsatisfactory condition, mostly bruized, bleeding, or mouldy

ii. SMALL NATAL'S IN COOL CHAMBER.

Marks.	No. of Fruits.	Weight.	Condition when Shipped.	Commercial Agent's Report.	Gross Receipts
		lbs.			s. d.
X	12	1¾-2	21 cases of 12 pines each from Winkle Spruit Expmt. Farm. Coloured on plants to a yellow colour; quite fresh. Lot G, 11 cases of smallish pines, not well nor carefully handled; forwarded without particular selection; some treated with secret preservative	An attractive clean pine though a dull yellow; arrived on the whole in splendid condition; crowns excellent; a pine that sells well, but should be a little bigger; say 2lbs. to 2¼lbs	... Average 5s. per case.
G		¾	Two cases of 12 each; specially selected and not treated with preservative; well coloured.	Nice looking fruit and good crowns; slightly specked.	6s. per case.
G	18	½	Full coloured; treated with preservative (1 case)	Two specked, dirty looking, and all rather soft to touch; crowns withered	9 0
G	20		Two cases; fully ripe; treated with preservative	First case—Two rotten, others mostly mildewed, probably caused by "cure" Second case—Fruits over ripe, the "cure" gives a filthy appearance; all soft	Average, 4s. 4d.
G	20		Six cases; not treated with preservative; all well coloured and ripe	Arrived all fully ripe and in mueh better condition than above	

iii. SMALL NATAL'S IN VENTILATED HOLD.

This lot, consisting of 15 cases of green fruits purchased upon the market, was graded out in accordance with size and appearance and forwarded by ventilated hold.

Marks.	No. of Fruits.	Weight.	Condition when Shipped.	Commercial Agent's Report.	Gross Receipts
		lbs.			
F	12	1¾	13 cases of 12 fruits	All 15 cases opened up of a bright readish colour; arrived in splendid condition: the following are notes on each case:—	Average, 4s. 6d. per case
	18	1½	1 „ 18 „		
	24	1	1 „ 24 „		
				1 Sound; good conditioned crowns: one fruit "specked"	
				2 Nice crowns, but little discoloured and weak; fruit sound; a few specs	
				3 A number specked; one rotten	
				4	
				5	
				6 Excellent cases: good stiff crowns, and only a little discoloured at the tips	
				7	
				8	
				9	
				10 Very good case; bigger crowns and firm	
				11 Three fruits slightly discoloured	
				12 Very good; crowns much more attractive, and better condition than Capes	
				13	
				14 Case of 18 pines; all sound; bright colour	
				15 Case of 24 pines; very small; all good	

CAYENNES.

Condition on Arrival and Prices.

The prices realised for the sound Cayennes were from 9d. to 1s. 6d. each, and the condition upon arrival very much the same as packed. What is so pronounced is that the pines which were picked, handled and forwarded to me carefully arrived sound, whereas in other lots bruizing and bleeding is a marked feature. The only Cayennes that were properly handled and carefully forwarded were 10 from Winkel Spruit. These weighed about 3 lbs. to 3¾ lbs. each and realised 1s. 4d. each; these are reported upon as follows:—

"Very fine even colour, splendid crowns and sound fruit. A pine which should have a big vogue, if consistently good on arrival."

CONCLUSIONS.

It is so absolutely impossible to reconcile some of the features of the above reports in respect to the condition upon arrival and the prices

ealised that I do not propose to attempt any explanation. The prices btained for small Queens in the first and third shipments compare ver/ ell, but the gross returns of the second shipment destroy the confidence ne others inspire. Taking the Winkel Spruit pines alone we find that the first shipment they fetched 6s. and 7s. per dozen, and in the third n average of 5s. was obtained. The same fruit in the second shipment ealised 3s. per dozen. But there are far greater discrepancies than these.

So far as Cayennes are concerned the prices realised, particularly in he third shipment, are so at varience with the reports that I can only onclude that the prices given in the official account sales bear no relation hatever to the packages against which they are set.

Otherwise the results are practically those arrived at in the first eries of shipments. That is by sending selected pines of 1½ to 2 lbs. in eight, which are well and carefully packed, a nett return of 2s. to 2s. 6d. er dozen may be expected.

3RD SERIES.

The 3rd series comprised two shipments, one of 136 boxes and one f 82 boxes shipped in August. These were made by special request and he senders looking upon the trial as "a practical one" and paying the xpenses. All the pines, weighing 1¼ lb. and upwards, were sent from ne field. Unfortunately these pines were forwarded as in all other cases o the Point for packing and had been injured in transit. Of course, etectable injuries were eliminated, but it is not always possible to detect ll injuries received in transit. Again these pines suffered from black ore or specking. The experiment was a failure and did not clear ex- enses, involving the loss of the boxwood and the value of the fruit. As n experiment, however, it was valuable as showing the necessity for hipping only carefully selected and well-grown pines.

GENERAL CONCLUSIONS.

The following conclusions may be said to be based upon practical perience, but they only take into consideration the series of shipments which I have been directly interested, full particulars of which are ven above or in my previous report.

There have been numerous minor private experiments made by as any individuals, but unfortunately those who make these experiments o not publish the results, and what little one hears about them precludes ny possibility of arriving at a correct estimate of their value.

The question of pineapple export is, however, an important one and ould not be lost sight of because no particular success has been achieved the past. To my mind it can be made more important, I believe more ermanent and remunerative, than naartje export.

Pineapple culture can hardly be said to be a good paying proposi- on in Natal to-day, and as an industry it is upon the whole a decadent

one. With few exceptions, and then chiefly by growers of Cayennes, little attention is given to advanced pineapple culture—a state of affairs largely attributed to continued disappointments.

Before pineapple export can be made a success and placed upon an assured basis, it is obvious to me that advanced methods and specialisation must occur in the culture of the Small Natal pine. In this connection I think we can safely leave out of consideration other varieties.

Generally speaking only two varieties are grown; these are the smooth-leaved Cayenne—a close relative if not identical with the Azores pineapple and the "Small Natal," for which the name "Golden Queen" has been suggested. It is necessary here to point out that the term "Queen pine" is frequently attached to the large Cayenne, presumably, I suppose, because its large size gives it a regal appearance. A few gentlemen have imported and grown other kinds, of which there is a wide variety, but no remarkable results have been achieved.

It will be noted from the reports that a considerable number of Cayenne pines were used throughout the experiments, and it is well to mention that small lots of this variety are frequently shipped by various parties to London.

There are, however, so many drawbacks to the shipment of this kind that I do not presume to recommend it strongly as an export line. In the first place it is a fruit which must always be shipped by cool chamber, and our experiments have demonstrated three things in this connection. These are (1) that pineapples do not colour up in the cool chamber, (2) upon removal they do not colour up after being kept so long under the influence of the low temperature, and (3) the keeping qualities are considerably impaired—a feature which depreciates the market value at once.

As this variety does not colour up as does the small Queen if picked green, its shipment by any other means than cool chamber is out of the question. More than this, they do not colour up evenly upon the plants, and must be harvested for several reasons before they are well ripened. It was found that if fairly coloured when picked they will colour up quite well, a great improvement being effected if packed and allowed to colour under such conditions at the ordinary temperature.

The worst feature of this fruit is its tendency to "Bleed." In fact the finest examples bleed sometimes most profusely. Our experiments showed that bleeding fruit came out of the cool chamber still bleeding, and also that bleeding would arise in the cool chamber. To my mind this feature alone makes the fruit undesirable for export purposes as it is one that cannot be guarded and so large a proportion are apt to start bleeding.

A further drawback is the uncertainty as to prices. With success

we may expect 1s. apiece as a steady uniform price for pines of the ger type (3½ to 5½ lbs.) arriving in good condition. It will be noticed om the experiments that these fruits packed 8—10 and 12 to the box, e average pack works out at 10 to the package, which was 40 x 20 x 7 ches, or 12 boxes to the ship's ton. Otherwise, at 60s. per ton, the eight alone works out at 6d. per pine and the boxes at 1½d. per fruit.

As pointed out elsewhere, small Cayennes of 2 to 2½ lbs. are exactly a par with large Natal or Golden Queens, and may be expected to tch 8s. per dozen, or a profit of 3s. to 4s. per dozen, which, if it can be aintained, is a very promising feature of the experiment.

However, what hopes there are to build one upon more solid founda-ons are in relation to the export of our Natal Golden Queen.

In the first place there can be no question that for export purposes nprovement by selection, care and culture has to receive primary atten-ion. That such is the case is illustrated in the Winkel Spruit lots, which ere not specially selected but which were grown upon good principles.

It can be said at once that fit pines for export will only be obtained om "plant" and 1st rattoons. That is first and second crops. Not lone because of the size question, but what is more important, that is specking." "Specking" is the external evidence of brown rot, and this ouble is less pronounced in "plant" and first year ratoons than it is in d plantations. There is no doubt that as the plants get older this sease gets worse, and it gets worse first because of debility, but more so because the fruit has greater opportunities of becoming affected.

Brown rot, as is well known, does not destroy the whole of the pine, ut it ruins its appearance. It starts from the eye and drives inward to he core, and is due to a mould which is reasonably supposed to gain its ntrance through the flowers, the spores being probably distributed by sects. It stands to reason that the older the plantation becomes the reater the ascendency of this parasite.

"Specking" is a dangerous trouble, because it is not manifest in reen pines and is frequently undiscernable in quite ripe pines. If my servations go for anything the cool chambering seems to bring it into ore prominence as care was taken to eliminate pines which showed any dication of "speck" when packing, and yet many opened up badly fected.

A strong feature brought out by the experiments was that pineapples r export must be carefully handled. Indeed, it is of primary import-nce that they should be carefully picked and as carefully removed from he fields to the packing houses. Gloves should always be supplied to the ickers, not that the fruit can be injured by the hands, but that the hands eing protected no accidents happen to the fruit. Further, I am satisfied hat the fruit should be kept in single layers, or at any rate that a buffer

of grass or such-like soft material should be used between each layer when the fruit is being harvested and transported to the packing house. In short, I am sure it is easy to injure a pineapple sufficiently from the field to the packing house so that when it arrives in London that injury has become very pronounced. This applies in whatever stage the fruit is picked.

So far as shipment is concerned, there are two means of shipment, cool chamber and ventilated hold, and a grower can choose either or both, but he is limited each way by the stage of maturity of each fruit as indicated by the degree of colour manifest.

If the ventilated hold is chosen then certain considerations have to be taken in mind. The first of these is that the fruit must be picked dark green without any pale green or yellow showing and only a few days days (three at most) before the date of shipment. That is if the steamer leaves on Thursday the fruit should be picked upon Tuesday. From all that I can gather, ventilated hold shipments must be confined to quite green fruit, harvested and packed within three days of shipment.

If the cool chamber is chosen the shipper is not tied down to so restricted a time limit.

What he must do in sizing his fruit, however, is to grade it out in accordance with the degree of colour, and he will find that he can make out about four colour degrees between the pale green and the full yellow of the matured fruit. If he does this he can do his packing uninterruptedly and ship his fruit after it has coloured up nicely, because he knows that it will open up at the other end of its journey almost if not exactly in that degree of colour which it attained just prior to being placed in the cool chamber.

Pineapples can be sized with little practice by eye and their grading is not at all difficult. Upon any indication of a damaged or diseased eye fruits should be rejected. It will also be found profitable in grading to put those with nice well-formed crowns together, making a selected package of them. They should always be cut with 1½ in. to 2 in. of stalk, the larger Cayennes having 3 in. to 4 in. left.

No particular advantage comes of sealing the stalk ends, and it is far preferable to cut the stalks straight across and to the right length when harvesting than to cut roughly and trim up afterwards.

The leaves about the base should be pulled off and the pine dressed in that respect. Before wrapping the fruit should be brushed over, preferably with a good soft bannister broom so as to remove all grit, sand and dust. The whole, the crown and fruit, is best wrapped, as otherwise no matter how clean the packing material, a certain amount of dust is bound to filter in on the fruit. The dust and fragments in even the best wood-wool was found to give the fruit a dirty appearance.

The packing material should be coarse and springy; there are only two suitable materials, and these are wood-wool and shredded mealie husks. A coarse wood-wool is far preferable to the fine, good quality stuff usually used for fruits, and which rather tells upon the fruit than favours it. If the fruit is wrapped, packing material is not necessary between the fruit, but a layer is required beneath and above and at the sides. The use of fine wood-wool and the use of too much interferes with the ventilation of the package and seems to cause sweating.

Only the clean inner leaves off the cobs can be used for packing, and even these are worse than wood-wool if not thoroughly shredded into narrow strips.

Miscellaneous Fruit Export.

Summer Fruits.

The export of summer fruits from Natal is a matter which does not hold out much of a future. Our climatic conditions are such that fruits of good carrying qualities can hardly be produced. If any development is to take place I fear it can only be with early plums and late apples. Against even this is the question of hailstorms, whose very vehemence is unfortunately confined to our best apple and pear growing districts.

In connection with this particular vagary of the elements numerous enquiries have been set upon foot, but little if anything of value has been ascertained, and hail prevention seems, as ever, in the clouds.

Experiments are now in progress in connection with hail-guards for fruit trees and galvanised woven wire screens, after the pattern of the spring mattress, are under trial. These are at present very expensive, running to 20s. per tree; their effectiveness can, I think, be relied upon, but their durability is an open question.

A report has already been furnished upon a trial shipment of Methley plums to London and further shipments are arranged for next season. The original shipment, owing to the early appearance of the variety upon the market, proved most encouraging, and, in conjunction with next season's trial an effort will be made to increase the size of this local sort by heavy thinning of the crop.

Tropical Fruits.

In the export of Avocados and Mangos there appears to be, from the small experiments made, a promise of a remunerative if limited export, but both these lines require further exploitation.

The question of Banana export is one cropping up frequently both as regards the fresh fruit, dried bananas, banana figs and banana flour. For the present this is not a matter of moment. It is scarcely credible that fresh bananas will ever be exported from here to Europe, and with

the progress and growth of South Africa it will, I opine, be a very long while before banana culture here will do any more than meet the local demand, and so there will be no surplus to turn into either figs or flour.

Locusts.

For the first summer during my term as Entomologist locusts have been a negligable quantity, no damage having been done by either fliers or hoppers. Early arrangements were made to meet any possible hatching of hoppers, supplies being dispatched to depots throughout Zululand and to other likely centres. Fortunately, the threatened invasion, heralded by a southward flight of redwing locusts in the early spring, came to nothing, and eggs were only laid over a limited area in the Lower Illovo district, the resulting hoppers being speedily destroyed.

The previous season a great deal of the work was accomplished with prepared poison and our arrangements for this year anticipated the general use of this. This poison was prepared according to Lounsbury's suggestions and was greatly appreciated, especially by our most experienced officers, who found its use more economic and possessing many advantages over the older methods.

Coincident with the abatement of the Red wing locust the Brown locust of the other Colonies has also practically disappeared. It is hardly credible that these two very different insects are influenced by the same natural conditions; and, although for years past both have been at their worst, there have been periods when Brown locusts ravaged the high veld of the Free State and the Transvaal, whilst Natal enjoyed complete immunity from the incursion of any locusts.

It has always been anticipated that history would in time repeat itself and the Redwing locust would disappear from Natal in obedience to some natural cause. To-day this is generally thought to be the case without any natural phenomenon to account for it.

There has, of course, been an ascendancy of natural agents, for in 1906 the fliers were decimated by disease throughout parts of Zululand, and egg-parasites have been more abundant of recent years, but neither of these agents, nor the more recent assistance rendered by the white stork, have been sufficient to explain the situation of to-day. Indeed, there is every reason for assuming that the benign conditions now prevailing as regards the Brown locust are entierly due to the systematic operations against them, and it is far more reasonable to assume that our own present happy circumstances are due to similar and long-continued efforts coming to fruition as soon as effective hopper destruction was carried on to the north of our sphere of operations.

Granting that the destruction work is to be credited with its full effect, at least it can be said that the finishing touches have been applied by natural agencies. It is my opinion to-day that the campaigns con-

:cted have so lessened the locusts that they have been at last overcome their natural enemies, the chief factor happening to be the "White ork."

Where the Redwing locusts are at present it is not just now possible say, but it is inadvisable to assume that the insects have been ex- rminated and unwise to relax our vigilance in watching for indications fresh invasions. Indeed, the work of locust destruction should now : done even farther afield, and should either species assume menacing oportions to the north of South Africa there would be every justifica- on for our taking steps for their destruction, because as certain as they ıcrease there so certainly will they swoop down upon our territory.

Wattle Insects and Wattle Troubles.

The wattle-growing industry of Natal has been a remarkable de- elopment from its inception, and every year sees more and more of our irgin acres broken to sustain this wealth-producing tree. In 1898 attle culture had assumed no mean proportions, there being some 9,515 res in existence, and ten years later (1908) the area was returned at 8,444, the land, buildings and machinery alone representing £260,630, ıd still the rate of extension shows no signs of diminution.

With the exception of the Australian Bug—a pest that does not unt because of the general distribution of its natural enemy—the dalia beetle—the wattle enjoys complete immunity from the one ındred and one insect and fungus parasites of which it is the natural st in its native land.

The attacks of white ants upon plantations have further been con- ɔlled quite effectively wherever the suggestion thrown out by this office s been adopted; that is, the destruction of all termite nests in the gin lands before they have been ploughed by pumping in arsenic and lphur fumes.

From the inception of wattle culture some of the insects which ist upon the native mimosas took to the cultivated plant, chief among ese being the bag-worm and several defoliating caterpillars and beetles. nce then several other insects have acquired a liking for the plants, and e attack of a small capsid bug, a trouble coming more into prominence late, bids fair to prove one of the most important of all.

It is only natural that the greater development of the industry ould lead to some unusual increase in the native insects of the mimosas, ıd there is no doubt that the near future will call for an extended vestigation into these subjects. Diseases other than insect attacks ıve not come into any particular prominence, but disturbances of a ıysiological nature have several times come under notice.

Mealie Top Grub.

In view of the divergent opinions held with regard to the life-cycle

and development of the mealie top grub, some further field observations were carried out in the spring. There were all confirmatory of those previously made, and it may be interesting to state that pieces of stalk and stumps collected from newly ploughed lands at Thornybush as late as the 23rd of November contained over-winter caterpillars. These were, of course, exceptionally late, and at the time they were taken pupæ were also found and adult moths were already upon the wing.

The true and economic plan of dealing with this pest is by clearing off all stumps and stalks before the insects have transformed, and as this can be done as late as the last week in August the excuse formerly urged that the stalks were required for winter food no longer carries weight.

In addition to this measure comes the planting as early as possible of a small area of mealies, even if such entails irrigation, to act as a trap crop.

The control of the grub in the field, when taken in time, can be effectively done by pouring poison into the "cups" of the plants, and arsenate of lead has proved the safest form in which to apply this. At the same time such a treatment can scarcely be called an economic one, and at the best only one that can be carried out upon a small scale.

The damage done in a field of mealies by the top grub is due to the fact that at a certain stage of growth the caterpillars wander afield and bore into the stems of sound plants and destroy the core in which at that stage the future tassle and cob are already formed.

The moth does not lay an egg upon each plant, but as a rule deposits a fairly large brood upon individual plants. The young feed upon these plants and riddle them, subsequently wandering off and attacking the field wholesale. It is, therefore, readily realised that originally only a percentage of plants are infested, and consequently a great deal of damage can be lessened by cutting out the plants upon which the young grubs abound. In this stage the grubs are a quarter to half-an-inch in length and of a black colour and quite easily discovered.

A proposal which was seriously put forward some time ago, and which I understand has been adopted with some success by several farmers, is to mow off the mealies right through the field when the first indications of grub attack are noticed. Of course this could only be done whilst the core of the plant is still at a low elevation, because it would ruin the plants to cut below the growing point of the core, which in the very early stage contains in embryo form the future leaves, stem, cobs and tassel. Done at any time, this cutting back checks the growth of the plant, sometimes quite considerably, and the treatment is not one that should be adopted without some consideration and experiment.

Mealie Weevil.

Whilst tanking and carbon bisulphide treatment for the control of

weevil attack are both being adopted, weevil attack remains a very serious consideration for the farmer, the buyer and the shipper.

By recent tests of a varied nature it has been clearly demonstrated that moisture is particularly essential to the life and activity of weevils, and it is this fact which explains the immunity of kiln-dried mealies and the comparative immunity of cob-mealies which are hung up to dry or stored in open and thoroughly well ventilated bins. I mention this as indicating that in connection with weevil attack alone, thorough drying is of first importance to the farmer, and much greater attention should be given thereto.

Speaking broadly, all mealies when harvested may be regarded as weevil infested, because primary infestation usually takes place in the fields. The first attack is slight—a very small affair—but it depends upon just how the grain is treated after harvesting whether it develops into a gross infestation or not.

Because of the weevil test to which grain for export is submitted—the mere presence of a few live weevils condemns a shipment—it is, to my mind, very much a matter of luck whether a consignment gets away.

For instance, "A" forwards 500 bags, they arrive with but little delay on rail, are examined, passed, and expeditiously shipped. He sends a similar quantity a day or so later and when they arrive at the Point they are immediately examined and passed, but a week elapses before they can be shipped; the second examination reveals the presence of weevils, and they are condemned. Strictly speaking, they are no more weevil-infested than the first consignment.

It is the general experience of marine surveyors in England that no cargo ever arrives that is absolutely free from weevil, and so under such circumstances it is obvious that some account might reasonably be taken of the degree of infestation exhibited by a consignment when examined this side.

If at no other time, some justification exists for certain relaxation of the test from September to January for the very simple reason that light infestations are not apt to develop dangerously, because as soon as the steamer gets north of the Equator its entrance into cold waters brings the activity of the insect to a standstill, and the weevils are killed by the cold prevailing when the grain is landed.

Considering the vast amount of grain which has been condemned in the past on account of light weevil infestation, it becomes almost imperative to evolve some scheme, such as the Clayton gas process, which should meet the case if it does what is claimed of it, for treating mealies before shipment and possibly in the ship's holds. More especially will this be the case if ever bulk shipment is adopted, because there can be no doubt that owing to the mealies being shipped as at present in bags,

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PLANT IMPORT INSPECTIONS.

The subjoined table gives the various plant imports arriving at Durban during the past three financial years which have been examined or passed by the Inspector of Plant Imports:—

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The correspondence of this office has largely fallen off, chiefly owing, I believe, to the fact that so much time was given up to fruit export, and, of course, to the decrease of office work incidental to the disappearance of locusts.

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a certain amount of ventilation is provided which permits of evaporation, rendering the grain less liable to gross infestation.

Potato Imports.

Considerably greater attention has been given to the inspection of imported potatoes during the past twelve months than ever in the past.

The recognition by the Transvaal authorities of several potato troubles as being particularly pestivorous and the economic importance of two hitherto little known diseases has brought this about.

Under the new arrangement any consignment showing indications of disease is condemned, but in some cases importers are allowed to sort over their consignments. Quite the majority of consignments arriving within the last twelve months have been sorted before leaving the port.

Potatoes imported for seed purposes have been found to be affected by a number of diseases, and, although such inspections and precautions cannot give any absolute prevention against the introduction of disease by this means, the work does to a great extent safeguard the grower, and it has certainly resulted in keeping out of the country a number of consignments of very badly diseased seed.

Although at first importers and senders contended that it was impossible to ship sound potatoes and that such diseases as the seed might contain were of no particular moment, I have no hesitation in contradicting both arguments.

Fruit Fly.

The control of the Fruit Fly now appears within reasonable distance, in view of the success attending the application of Mally's bait. Trials which have been made in several citrus orchards have been attended with remarkable effects, and where the treatment has been applied for the melon fly, which attacks squashes, marrows, pumpkins and the like, it has proved equally sucessful.

Reports and Publications.

The last regular annual report of this office was for the year ending 30th June, 1906. Very soon after this period the Chief Locust Officer was retired, and I lost the serives of the Technical Assistant. The whole of the 1906-7 locust campaign had to be undertaken by myself with the sole assistance of Mr. Kelly. The work involved a great amount of time, and at the close of the campaign a special effort was made to adjust the stock lists and accounts of previous years, which were in great confusion. At the close of this work Mr. Kelly was seconded to the Orange River Colony Service, and under instructions a short course of lectures were given at Cedara. Disorganisation soon followed with the calling out of the Militia late in 1907, and upon the return of my assistant it was only possible to carry through and wind up the 1907-8 locust campaign in time to undertake the 1908 departmental export of

citrus. From then until quite recently that work—extending over 1909—has fully occupied the attention of myself and my small staff.

As is only natural under the circumstances, reports and publications have not had special consideration. A special report was published upon the 1908 cirtrus export, and the following tabulated statement shows the contributions made to the *Agricultural Journal* since 30th June, 1906. Incidentally it may be mentioned that both the first and second Annual Reports of the South African Central Locust Bureau were prepared and edited for publication in the interim.

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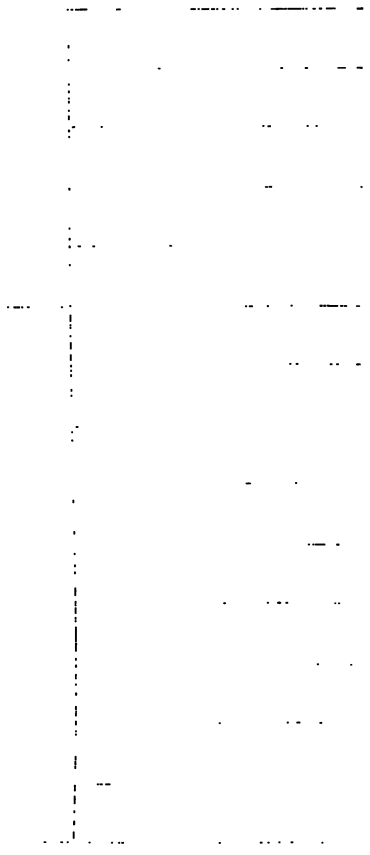

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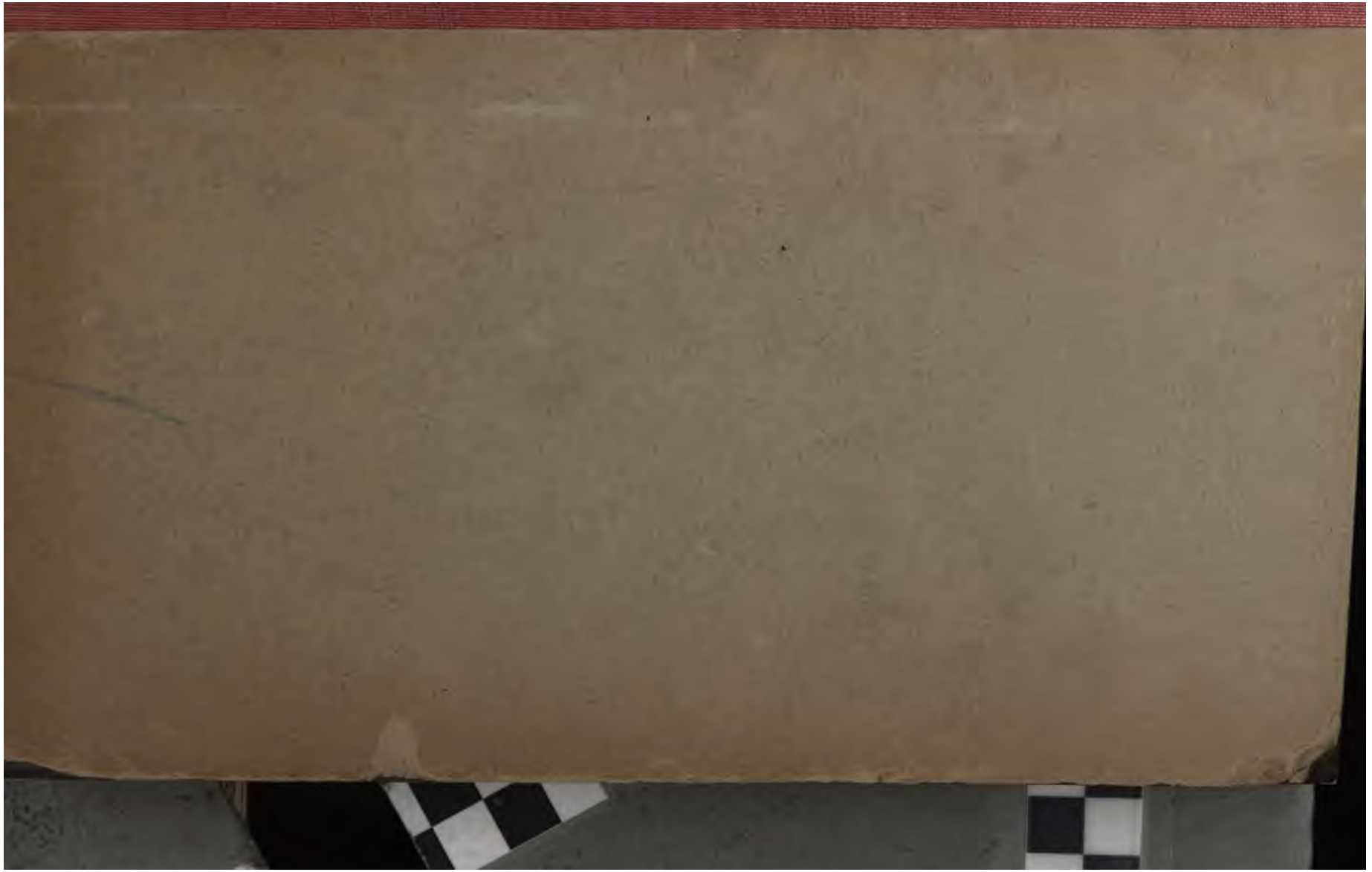
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